Chapter 3
Scope & Sequence of Technology Education

MISSOURI TECHNOLOGY EDUCATION GUIDE
2002 v. 2.1

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Scope & Sequence of Technology Education Programs

Acknowledgements

The project staff recognizes the hard work and dedication the many professional educators around the state of Missouri have given to this project. It is the dedication and forward thinking vision of such professionals that contribute significantly to the advancement and improvement of the study of technology in Missouri. Therefore, we owe a great deal to those professionals who worked tirelessly on this scope and sequence document.

The following individuals provided review and feedback for the revised Missouri Technology Education Scope and Sequence. For that, we, the project staff, are very grateful:

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Scope & Sequence of Technology Education Programs

Executive Summary

The revised Missouri Technology Education Scope & Sequence is a living document responding to current and future needs of Missouri's students, communities, and economies. This revised edition has added two **optional** programs in order to broaden the opportunities and choices students have in preparing for their future studies and/or future careers. The Industrial Technology program has been retained in full and remains a viable program option for the Local Education Agency (LEA).

The *Exploring Technology Careers* program will provide opportunities for students to have hands-on experiences in contextual learning while emphasizing academic rigor. A major problem recognized by many educators and parents is that students often finish high school without a sound understanding of what they want to do or should do with their lives. *Exploring Technology Careers* has the potential of helping students intelligently focus on career clusters that complement their individual strengths and interests. In addition, upon completion of the program, students will have developed academic and hands-on skills helping them to be prepared for post-secondary education in a field of their interest and choice.

The *Project Lead the Way*© (PLTW©) program option will provide students with intensive high academic and practical application learning opportunities preparing them for post-secondary two or four year engineering or engineering technology programs. PLTW© begins at the middle school level with an introduction to inventing and innovation and ends with a capstone course allowing students to demonstrate what they know and are able do to design solutions to real problems.

Exploring Technology Careers and PLTW© programs have the endorsement of the Division of Career Education (formally, the Division of Vocational & Adult Education), Missouri Department of Elementary & Secondary Education, as viable options within the Technology Education field of study. The PLTW© program will be eligible for Career Education Program approval in the 2004-05 academic year while the *Exploring Technology Careers* program will be considered for program approval in 2005-06. This approval will allow the LEA to count these courses as vocational credit courses.

The included course descriptions and course outlines provide suggested content based on the national *Standards for Technological Literacy* and the *Missouri Show-Me Standards*. Technology education teachers are encouraged to develop their courses based on the suggested content and standards, but it is up to the individual professional teacher to decide the best method of delivery.

Rationale for Technology Education in Missouri

1. Introduction

Technology has been going on since humans first formed a blade from a piece of flint, harnessed fire, or dragged a sharp stick across the ground to create a furrow for planting seeds, but today it exists to a degree unprecedented in history. Planes, trains, and automobiles carry people and cargo from place to place at high speeds. Telephones, television, and computer networks help people communicate with others across the street or around the world. Medical technologies, from Magnetic Resonance Imaging (MRI) to vaccines, help people to live longer, healthier lives. Furthermore, technology is evolving at an extraordinary rate, with new technologies being created and existing technologies being improved and extended.

Humans have been called the animals that make things (as well as design things), and at no time in history has that been as apparent as the present. The U.S. Patent Office reports that since its beginning in 1792, about 70% of all U.S. patents ever issued have been since 1935. More than a third of all patents have been issued in the past twenty years.

Today every human activity is dependent upon various tools, machines, and systems, from growing food and providing shelter to communication, healthcare, and entertainment. Some machines, like the tractor, speed up and make more efficient activities that humans have done for hundreds or thousands of years. Others, such as the airplane or the Internet, make possible things that humans have never been able to do before. This collection of devices, capabilities, and the knowledge that accompanies them is called technology (Dyrenfurth & Kozak, 1991).

We are a nation increasingly dependent on technology. Yet, in spite of this dependence, U.S. society is largely ignorant of the history and fundamental nature of the technology that sustains it. The result is a public that is disengaged from the decisions that are helping shape its technological future. In a country founded on democratic principles, this is a dangerous situation. In an August 2003 National Science Foundation funded report from the *National Science Board (NSF)*, it is clearly stated:

> Science and technology have been and will continue to be engines of US economic growth and national security. Excellence in discovery and innovation in science and engineering derive from an ample and well-educated workforce – skilled practitioners with two- and four-year degrees and beyond, researchers and educators with advanced degrees, and pre-college teachers of mathematics and science [*and technology*] (NSF, 2003, p. 1).

The *U.S. Commission on National Security/21st Century* (2001) also spelled out clearly the importance of technology:

> The scale and nature of the ongoing revolution in science and technology, and what this implies for the quality of human capital in the 21st century, pose critical national security challenges for the United States. Second only to a weapon of mass destruction detonating in an American city, we can think of nothing more dangerous than a failure to manage properly science, technology, and education for the common good over the next quarter century (NSF, 2003, p. 1).

With the growing importance of technology to our society, it is vital that students receive an education that emphasizes technological literacy. (ITEA, 2000) This document, together with the national *Standards for Technological Literacy: Content for the Study of Technology*, present a vision of what students should know and be able to do in order to be technologically literate, and what school programs should look like to achieve that vision. Yet, the study of technology cannot and does not exist in a vacuum isolated from other academic and career subjects. The delivery of technology education must share in this responsibility and be a contributing member of the school instructional team to enhance core academic knowledge and skills, especially mathematics and science.

2. Definitions and Terms

Career Exploration: The process of examining and experiencing, through classroom and hands-on laboratory activities, various career opportunities. This process includes self discovery of interest, talents, and capabilities as well as acquiring basic knowledge and skills required for advanced studies and training in career paths of interest.

Design: Technological Design, according to the *Standards for Technological Literacy*, *Content for the Study of Technology (STL)*, is a distinctive process which has a number of defining characteristics. Design is a process which has a defined purpose with identifiable requirements (constraints) and follows a systematic approach allowing for iteration. The design process encourages human creativity utilizing intuition, feelings, and impressions leading to the designer's "best possible solution."

Engineering: Engineering is the art of applying scientific and mathematical principles, experience, judgment, and common sense to make things that benefit people. Engineering is the process of producing a technical product or system to meet a specific need. In other words, engineering is a process used for solving problems relevant to our lives.

Engineering Technology: Engineering technology is the profession in which knowledge of mathematics and natural sciences are used to create and enhance technologies that benefit humanity. Engineering technologists and technicians deal with application, manufacturing, implementation, engineering operation, sales, and production as opposed to the conceptual design and research functions performed by many engineers.

Missouri Career Paths: These clusters of occupations that require different levels of education and training. People working in a career path share interests, abilities, and talents. Career Paths help students identify a career focus without being locked into a specific occupation. With career paths, students are able to begin preparing for a career, but still have the flexibility needed in today's constantly shifting work world. Missouri has identified six Career Paths that are broad in nature. The Career Paths that Technology Education pays close attention to are shown in bold font. The States' Career Clusters that match with the Missouri Career Paths follow each cluster (see Table 1).

Table 1
States' Career Clusters & Missouri Career Paths Comparison

Missouri Career Paths	States' Career Clusters
Arts and Communication	Arts, A/V Technology & Communications; Architecture and Construction
Business, Management & Technology	Science, Technology, Engineering & Mathematics
Industrial & Engineering Technology	Science, Technology, Engineering & Mathematics; Transportation, Distribution & Logistics; Manufacturing; and Architecture & Construction
Natural Resources/Agriculture	Agriculture, Food & Natural Resources
Health Services	Health Science
Human Services	Human Services

Professional Teacher/Educator: In the broadest sense, a professional educator is a teacher that never stops learning nor wants to stop learning. The professional educator continues to look for ways to improve instruction, knowledge, and collegiality with other professional educators. Professional growth begins the first day of their career and never ends (*The Master Teacher*, vol. 25, no. 34). Ultimately, this process of growth has only one goal, to serve the needs of their students today, tomorrow, and in the future. To the professional educator, successfully serving students requires a clear understanding of their needs. When a student walks into a technology teacher's classroom/lab, the student does not leave their academic or emotional needs outside. They step into the lab as a whole person with all of their emotional and academic needs attached. The professional educator has a clear understanding of not only the content of their course or program but that of other academic programs in the school building and the school district. Professional educators will be familiar with the entire K-12 curriculum, which better positions them to plan for their own programs and meet the needs of the whole student. Educators will be prepared to address core content as well as their own content found in their technology program. In addition, collegially, "…when teachers begin to show a

professional interest in and awareness of what colleagues are doing in their classrooms and schools, new staff relationships emerge." (*The Master Teacher*, vol. 21, no. 22) These new relationships will only help increase the capabilities of the professional educator who in turn helps students achieve academically.

States' Career Clusters: "A Career Cluster is a grouping of occupations and broad industries based on commonalities. Career clusters provide an *organizing tool* for schools, small learning communities, academies and magnet schools. Career clusters identify *Pathways* from secondary school to two- and four-year colleges, graduate school, and the workplace, so students can learn in school and what they can do in the future. This connection to future goals motivates students to work harder and enroll in more rigorous courses. Career clusters provide students with relevant contexts for learning" (National Association of State Directors of Career Technical Education Consortium, 2002). **States' Career Clusters,** as identified by the National Association of State Directors of Career Technical Education Consortium (http://www.careerclusters.org), are organized into sixteen groups. The career clusters Technology Education is most concerned with are shown in bold type (see Table 2).

Table 2
States' Career Clusters

Agriculture, Food, & Natural Resources	Health Science
Architecture & Construction	Human Services
Arts, A/V Technology & Communications	**Information Technology**
Business, Management & Administration	Law, Public Safety & Security
Education & Training	**Manufacturing**
Finance	Marketing, Sales & Service
Government & Public Administration	**Science, Technology, Engineering & Mathematics**
Hospitality & Tourism	**Transportation, Distribution & Logistic**

Technology: Broadly speaking, technology is how people modify the natural world to suit their own purposes. From the Greek word *techne*, meaning art or artifice or craft, technology literally means the act of making or crafting, but more generally it refers to the diverse collection of processes and knowledge that people use to extend human abilities and to satisfy human needs and wants through a process of design (ITEA, 2000, p. 2).

Technology Education (TE): The school subject that teaches about the processes used to design, create, and maintain the human-made world through the integration of technical, mathematical, and scientific knowledge and skills. (Technological studies, design and innovation and pre-engineering are other terms used to describe this subject area).

Technological Literacy: The ability to use, manage, assess, and understand technology. A technologically literate person understands (in increasingly sophisticated ways that evolve over time) what technology is, how it is created, and how it shapes society, and in turn is shaped by society. He or she would be able to hear a story about technology on television or read it in the newspaper and evaluate the information in the story intelligently, put that information in context, and form an opinion based on that information. A technologically literate person would be comfortable with and objective about technology neither scared of it nor infatuated with it (ITEA, 2000, p. 9).

Technology is the modification of the natural environment in order to satisfy perceived human needs and wants (ITEA, 2000, p. 9). A great benefit when learning about technology is the opportunity one has to do technology (ITEA, 2000, p. 2). A very strong implication in this definition of technology is that technology must involve design. The process of design is central to the practice of engineering and a key element in technology education. If one is good at design, it follows that one will have a tacit knowledge of materials, artifacts, and systems as they relate to each another (Technically Speaking, p.58). In learning to do design, students will master a set of abilities that will serve them well throughout their lives (ITEA, 2000, p. 2). However, design is often defined or viewed in various ways. It often means different things to different people. Therefore it is important to establish a common definition for design as it is addressed in this document. This will allow common ground and common understanding for the importance of design in education and more importantly, technology education.

3. Philosophy of Technology Education

Our world will be very different 10 or 20 years from now. We have no choice about that. We do, however, have a choice whether we march into that world with our eyes open, deciding for ourselves how we want it to be, or whether we let it push us along, ignorant and helpless to understand where we're going or why. A technological literate society will make the difference (ITEA, 2000, p. 10). The achievement of a technologically literate society is a societal goal that is supported by K-12 technology education programs.

Missouri's technology education profession affirms that its programs should teach about technology and use technology in a way that serves as a vehicle to build understanding, skills, and attitudes that can be applied to society in general, i.e., technological literacy, regardless of students' career aspirations. Furthermore because all people are affected by technology, and technology has an increasing presence in our lives, students from kindergarten to twelfth grade should be involved with learning about and learning to use technology. Learning should extend not only to enhancing human capability but to using technology to design the build environment (sometimes referred to as engineering

design). It is therefore recommended that a K-12 technology literacy program be in place in the state of Missouri to insure high school graduates are technologically literate.

A. Technology and Impacts on Daily Life as a Force Has Affected Most Aspects of Our Lives

Business and industry have been required to grapple with technology engendered issues such as design/engineering, productivity, technological capability and global competitiveness. Workers have been challenged to retrain and develop currently marketable skills—in cognitive, affective and psychomotor domains—in order to maintain their ability to support themselves and contribute to our free-enterprise economy. And with technology's advances, Americans find these skills to be constantly changing.

Legislators have also been pressed to understand technology and its effects as they work to frame policies for the public good. With the rampant escalation of both the amount and complexity of technology, it is increasingly difficult for people to exercise appropriate citizenship functions, particularly given the curtain of confusion raised by technology and its media offspring.

Consequently, citizens have often found themselves bewildered by increasingly complex consumer decisions. Frequently they face decisions involving trade-offs between immediate gains and negative consequences, e.g. the effects of toxic wastes. Similarly, recreational environments and activities have increasing technological components, as do personal and societal learning activities.

Technology's pervasive influence has permeated even our homes. Our lifestyle is timed, microwaved, accelerated, recorded, computerized and confounded. A greater proportion of people are working, families are resorting to schedules to program their contact, and others are unemployed due to technological advances. Outside knowledge is pouring into the home via cable television and other media. Not infrequently the tensions from external aspects of life, many of which are technologically induced, do come home in the form of stress.

Even in social service arenas such as the health sciences, technological capabilities have caused us to ponder when enough is enough. We ask, for example, to what end do we operate life support systems in situations currently deemed hopeless?

B. Technology and Social Context

Contemporary and future society is clearly different from what America experienced during its first industrial revolution. To be sure, some elements of the industrial revolution remain, but many more have changed. Technology as a force has affected most aspects of our life, and thus technology seems to be the single most distinctive characteristic that sets today and the future apart from our past.

Evidence of this is seen in the literature. For example, there are frequent references to the post-industrial society, from the demise/reduction of smoke stack industries and to the information society. Furthermore, we have seen tangible evidence of such shifts in our automotive, steel, petroleum and electronics industries.

C. Technology and Industry

But what is technology? Simply stated, it is human kind's use of tools, machines, materials, processes, energy, and knowledge (mathematical, scientific and technical) to satisfy its wants and needs. As such, it is not the search for an explanation of why things work - that is science.

Technology is knowing "how" to design, construct or build something with tools, machines, material processes and energy - and then it necessarily involves being able to do. Knowledge alone is not sufficient. Rather, technology is a combination of knowledge, skills and attitude that is always more powerful than any single component. It takes all of the preceding. Leave off one and the process is incomplete. Operating a machine is not technology in of it self.

Industry is one of human kind's basic institutions. As such, it parallels that of government, religion, and education. It is that institution that supplies our civilization with goods and services to fill our wants and needs. It does so by using technology. The technology used by industry is typically referred to as industrial technology.

D. Implications for Education

Given the pervasive nature of technology, the technology education profession raises the question: *"Where do people develop the understanding, skills and attitudes to deal with forces such as technology?"* Clearly our society uses formal schooling as a principal method to this end—at least for youth, and in increasing numbers, for adults. It follows then that one must ask, *"What are the schools doing to help youth and adults address technology's challenges?"* What systematic efforts are in place to develop technologically appropriate understanding, skills, and attitudes in elementary, secondary, post-secondary, adult and continuing education?

A technological program with a well developed standards-based scope and sequence is certainly the place to begin. Technology teachers have a bright future in the state of Missouri.

E. Technology Education's Relationship to Career and General Education

Given these contexts, it is clear that technology education must be an essential component of both general education, and career education (formally referred to as vocational education). Only in this way can technology education serve as:

- the component of general education that develops generalizable understandings, capabilities, values and attitudes related to technology in all youth.
- a reinforcement of core academic knowledge and skills through practical application in technology related activities.
- a component of specialized education that contributes to meaningful occupational choice and/or preparation in a technological society.

Because of these dimensions and TE's approach, it has an essential role in helping build the base that leads to successful transition plans such as Tech-Prep and/or 2+2 or 2+2+2 programs. Professional leaders need to be alert to opportunities that further the program's contributions to Missouri's youth as enabled by the Carl D. Perkins Vocational and Applied Technology Education Act.

4. Content of Technology Education

Just as technology spans across all aspects of human activity, technology education draws its content from the entire range of technological endeavors, not just industry. Content is also selected by identifying the competencies individuals need to effectively use the products of a technological society.

Given the preceding philosophy and foundation, it is clear that the educational program known as technology education derives its content, i.e. the subject matter it teaches, from technology, and not just industry. Technology Education is therefore considered to be a body of knowledge or a discipline.

Industrial technology is a subset of technology and many of its aspects can be generalized to technology. To clarify:

- Technology consists of all human productive endeavors including agriculture, bio- and medical technologies and engineering technologies.
- Industrial technology is the technology that is used by industry. As such, industrial technology coexists with agricultural and other technologies.
- Industrial technology consists of three technology system clusters: Materials & Processing, Energy & Power, and Communication.
- Industrial technology education focuses on learning the technologies of industry.
- Technology education focuses on all of the technologies used by human kind.

5. Mission and Goals of Technology Education

Since industry and technology are distinctive characteristics of American culture, and since one of the key purposes of education is to transmit the culture to future generations, it follows that it is necessary for the schools to provide youth with an insight into, an understanding of, and selected capabilities with the technological nature of this society. Industry and technology spring from the human ability to reason, solve problems, create/design/engineer, construct, and use materials, tools, machines and processes imaginatively. Because these abilities are an integral part of our technological culture

they should be developed in all students—regardless of their gender, background, educational goals or occupational aspirations.

The overarching mission of Technology Education as a school program is to develop the human potential of all students for responsible work, citizenship and leisure roles in a technological society. To accomplish this, programs must address each of its four primary missions, namely to:

- Develop each person's ability to comprehend and apply the concepts of technological systems through the design/engineering process which includes the integration and application of mathematical and scientific knowledge.
- Develop each person's values and attitudes related to the appropriate use of technology—its tools, machines, materials, processes, and products.
- Develop each person's ability to use materials, technological processes and hardware to achieve constructive work skills and enhance occupational opportunity.
- Develop an awareness of career options and the required technical and academic education for technologically related career clusters and career paths.

Technology Education addresses these four primary missions by purposefully working toward an important set of goals. Simply put, this means that every student participating in any technology education program should experience a systematically designed program of instruction and activity that accomplishes each of the 15 goals presented in Table 3.

Technology Education also operates within the context established by the *Standards for Technological Literacy: Content for the Study of Technology (STL)* and the *Missouri Show-Me Standards*. Technology Education is particularly capable of addressing the Show-Me Process Standards. By articulating carefully to such goals, Technology Education instructors can enhance the perceived value of their programs and they can increase the program's contribution to youth.

Table 3
Missouri Technology Education Program Goals
[as adapted from Missouri Technology Education Guide (2001)]

Every Student participating in technology education will experience a systematically designed and delivered program of instruction and activity that addresses two broad goals:

I. Understand and experience technology's creation, application, and control.
II. Understand and develop ways of thinking about technology that consistently respect the environment, promote human well-being, and benefit society.

Consistent with these two goals, technology education programs in Missouri enable students to:

1. Understand why and how people design, engineer, and innovate to meet human needs and wants.
2. Apply ways of thinking and doing essential to designing and problem solving, developing, making, managing, and assessing technological systems in various contexts.
3. Safely use, manage, and evaluate technological systems and engineering processes.
4. Relate technology with science, mathematics, and other subjects to understand systems in different contexts and to engineer solutions to practical problems.
5. Communicate technology content and processes, individually as well as in teams.
6. Understand the historical and future significance of engineered designs and impacts of technological solutions.
7. Develop basic skills in the safe use of tools, machines and processes used by industry and other technological areas.
8. Foster creativity in designing and using technology for desirable purposes by encouraging students to create, from materials and with technological processes and hardware, new and different forms which have greater or alternative value.
9. Facilitate the discovery of individual talents, aptitudes, interests and potentials related to technology through laboratory activity.
10. Encourage cooperative attitudes, constructive work habits and other traits that will help secure and maintain employment.
11. Develop pride in work done well.
12. Develop consumer skills related to the appropriate production, consumption and maintenance of technological goods and services.
13. Develop an awareness of and appreciation for career clusters and career pathways and opportunities in technology and engineering.
14. Prepare for entrance into advanced secondary and post-secondary career and technical programs by promoting the development of a basic foundation of career skills and interests.
15. Develop leadership skills through student organization activities.

6. Scope & Sequence

As the *Standards for Technological Literacy, Content for the Study of Technology© (STL©)* emerged on the national scene; the study of technology became clear and focused. The *Standards* unmistakably point to what students should know and be able to do to become technologically literate. Concurrently an underlying precept of technology education is that of providing career exploration to students. And, in addition to the *STL©* and career exploration, technology educators have the responsibility to reinforce the *Missouri Show-Me Standards* in the context of students studying technology. Tables 4 (page 13), 5 (page 14), and 6 (page 15) indicate standards that were used to help develop the courses found in this chapter, *Missouri Technology Education Scope & Sequence* with the exception of Project Lead the Way© courses which have the Standards embedded in the curriculum and will be available from PLTW©. The process of course development using standards is referred to as "Standards – Based" curriculum development. Matching standards to existing curriculum is referred to as "Standards – Related." It is important for teachers to review these tables to comprehend the foundation of what students should know and be able to do. Teachers may find it necessary and helpful to review these standards from time to time to assure their program is remaining standards focused.

The *Missouri Technology Education Scope & Sequence* was developed to incorporate the previously mentioned standards and goals. To facilitate this, the *Scope & Sequence* provides three program options to accomplish the Technology Education mission: 1. Pre-Engineering (*Project Lead the Way©*), 2. Exploring Careers through Technology Education, and 3. Industrial Technology (see Chart 1, page 12).

Chart 1
Missouri Technology Education Scope & Sequence

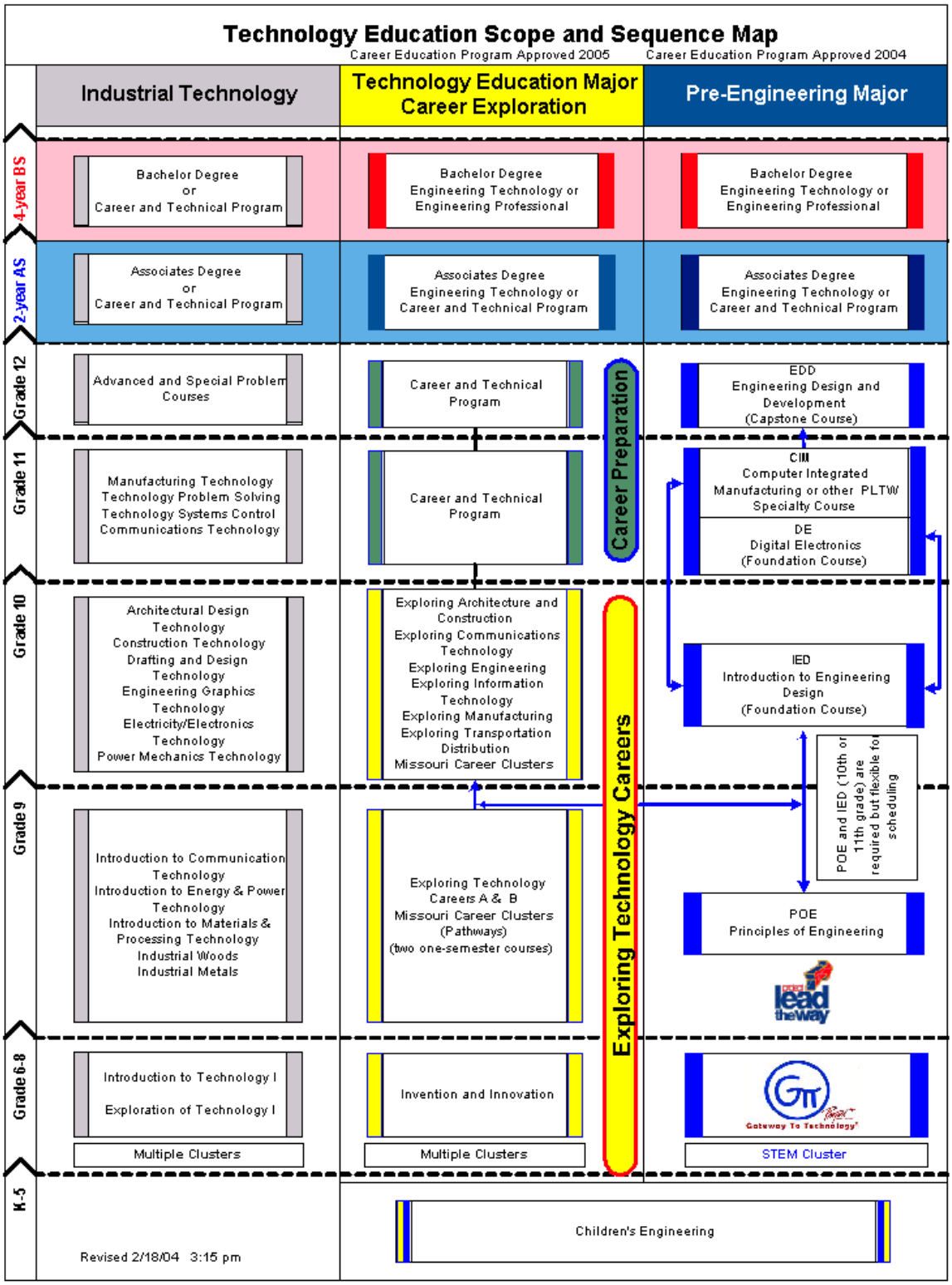

Table 4
Recommended Standards for Technological Literacy©*

Standards for Technological Literacy	Invention & Innovation	Exploring Technology Careers	Exploring Architecture & Construction	Exploring Communications Technology	Exploring Engineering	Exploring Information Technology	Exploring Manufacturing	Exploring Transportation & Distribution
Standard 1	X				X			
Standard 2	X				X			
Standard 3	X				X			
Standard 4	X	X			X			
Standard 5					X			
Standard 6	X				X			
Standard 7	X		X	X		X	X	X
Standard 8	X		X	X	X	X	X	X
Standard 9	X	X	X	X	X	X	X	X
Standard 10	X	X			X			
Standard 11	X	X	X	X	X	X	X	X
Standard 12	X	X	X	X		X	X	X
Standard 13	X	X						
Standard 14	X				X			
Standard 15	X				X			
Standard 16		X	X		X			
Standard 17	X	X		X		X		
Standard 18	X	X						X
Standard 19		X					X	
Standard 20	X	X	X		X			

*Standards for Technological Literacy: Content for the Study of Technology, International Technology Education Association© 2000, Reston, Virginia

Table 5
Recommended Missouri Show-Me Performance Standards

Performance Standards (Goals)	Invention & Innovation	Exploring Technology Careers	Exploring Architecture & Construction	Exploring Communications Technology	Exploring Engineering	Exploring Information Technology	Exploring Manufacturing	Exploring Transportation & Distribution
Goal 1.1	X	X	X	X	X	X	X	X
Goal 1.2	X	X	X	X	X	X	X	X
Goal 1.3								
Goal 1.4	X	X	X	X	X	X	X	X
Goal 1.5	X	X	X	X	X	X	X	X
Goal 1.6								
Goal 1.7	X				X			
Goal 1.8	X	X	X	X	X	X	X	X
Goal 1.9								
Goal 1.10	X	X	X	X	X	X	X	X
Goal 2.1	X	X	X	X	X	X	X	X
Goal 2.2	X				X			
Goal 2.3	X				X			
Goal 2.4								
Goal 2.5	X	X	X	X	X	X	X	X
Goal 2.6		X	X	X	X	X	X	X
Goal 2.7	X	X	X	X	X	X	X	X
Goal 3.1	X	X	X	X	X	X	X	X
Goal 3.2	X				X			
Goal 3.3	X				X			
Goal 3.4	X				X			
Goal 3.5	X				X			
Goal 3.6	X				X			
Goal 3.7	X				X			
Goal 3.8	X				X			
Goal 4.1	X				X			
Goal 4.2								
Goal 4.3	X				X			
Goal 4.4	X	X	X	X	X	X	X	X
Goal 4.5	X	X	X	X	X	X	X	X
Goal 4.6	X	X	X	X	X	X	X	X
Goal 4.7	X	X	X	X	X	X	X	X
Goal 4.8		X	X	X	X	X	X	X

Table 6
Recommended Missouri Show-Me Knowledge Standards

Knowledge Standards	Invention & Innovation	Exploring Technology Careers	Exploring Architecture & Construction	Exploring Communications Technology	Exploring Engineering	Exploring Information Technology	Exploring Manufacturing	Exploring Transportation & Distribution
Science S1								
Science S2	X				X		X	X
Science S3								
Science S4								
Science S5								
Science S6	X				X		X	X
Science S7	X				X			X
Science S8	X	X	X	X	X	X	X	X
Math M1	X	X	X	X	X	X	X	X
Math M2	X	X	X	X	X	X	X	X
Math M3					X			
Math M4	X				X			
Math M5								
Math M6	X				X			
Health/PE H1								
Health/PE H2								
Health/PE H3								
Health/PE H4								
Health/PE H5								
Health/PE H6	X	X	X	X	X	X	X	X
Health/PE H7	X	X	X	X	X	X	X	X
Fine Arts FA1	X		X	X				
Fine Arts FA2	X		X	X	X			
Fine Arts FA3								
Fine Arts FA4	X		X	X	X			
Fine Arts FA5	X		X					
Comm CA1	X	X	X	X	X	X	X	X
Comm CA2								
Comm CA3	X	X	X	X	X	X	X	X
Comm CA4	X	X	X	X	X	X	X	X
Comm CA5	X	X	X	X	X	X	X	X
Comm CA6	X	X	X	X	X	X	X	X
Comm CA7								
Social S SS1								
Social S SS2								
Social S SS3								
Social S SS4								
Social S SS5								X
Social S SS6								
Social S SS7								

A. Pre-Engineering Program

The *Pre-Engineering* program is a four year sequence of courses which, when combined with traditional mathematics and science courses, introduces students to the scope, rigor and discipline of engineering prior to entering college. Students successfully completing the program will be prepared to enter a postsecondary engineering or engineering technology program. However, those not intending to pursue further formal education will benefit greatly from the knowledge and logical thought processes that result from taking some or all of the courses provided in the curriculum. Students who complete the entire program have the opportunity to earn college credit. The curriculum for this option is provided by *Project Lead the Way*© (PLTW©) and should be coordinated through the Missouri PLTW© State Leader. PLTW© is a copy protected program that can only be used by contractual agreement between the local educational authority and PLTW©. The *Pre-Engineering* program is eligible for Career Education program approval. Course sequence follows the PLTW© format: Principles of Engineering, Introduction to Engineering Design, Computer Integrated Manufacturing, Digital Electronics, and a capstone course, Engineering Design and Development. PLTW also offers a middle school course called Gateway to Technology.

Pre-Engineering Program

Gateway to Technology

Project Lead the Way ©, Troy, NY

Course Description & Outline

Gateway to Technology© (Middle School) - the purpose of this course is to expose students to a broad overview of the field of technology and its related processes. Because engineers use mathematics, science, and technology to solve problems, the course has been designed to be "activity oriented."

It incorporates four units, each designed to be taught in a period of ten weeks. Each unit is an independent unit, developed specifically for the student's age and comprehension level. It is recommended that they be taught in the order shown in the outline below:

Unit 1 Design and Modeling

- Section 1.1 Introduction to Technology
  - 1.1.1 Definition of Technology
  - 1.1.2 Process of Change
    - 1.1.2.1 Timeline
    - 1.1.2.2 Invention/Innovation/Evolution
  - 1.1.3 Impacts on Society
    - 1.1.3.1 Positive and Negative Effects
    - 1.1.3.2 Ethical Considerations
  - 1.1.4 People in Technology
  - 1.1.5 Resources of Technology
- Section 1.2. The Design Process
  - 1.2.1 Design Brief
  - 1.2.2 Elements of Design
- Section 1.3 Sketching

- 1.3.1 Definition and purpose
- 1.3.2 Types of Sketches
  - 1.3.2.1 Thumbnails
    - 1.3.2.2 2 D Drawings
    - 1.3.2.3 3 D Drawings
- 1.3.3 Methods of Sketching
  - 1.3.3.1 Tools and Techniques
  - 1.3.3.2 Additive
  - 1.3.3.3 Subtractive

Section 1.4 Descriptive Geometry
- 1.4.1 Coordinate Systems
  - 1.4.1.1 Absolute
  - 1.4.1.2 Relative
  - 1.4.1.3 Polar
- 1.4.2 Basic Geometric Shapes
- 1.4.3 Geometric Relationships
- 1.4.4 Basic Solids

Section 1.5 Measurement
- 1.5.1 History and Purpose
- 1.5.2 Units
  - 1.5.2.1 English
  - 1.5.2.2 Metric
- 1.5.3 Instruments
  - 1.5.3.1 Rulers
  - 1.5.3.2 Calipers
  - 1.5.3.3 Protractors

Section 1.6 Computer Modeling
- 1.6.1 History and Purpose
- 1.6.2 Production of Models
- 1.6.3 Editing of Models
- 1.6.4 Documentation of Models
  - 1.6.4.1 Types of Drawings
    - 1.6.4.1.1 Orthographic
    - 1.6.4.1.2 Pictorial
  - 1.6.4.2 Annotation
    - 1.6.4.2.1 Dimensions
    - 1.6.4.2.2 Notes

Section 1.7 Model Fabrication
- 1.7.1 Model Materials
- 1.7.2 Types of Prototypes
  - 1.7.2.1 Hand Built
  - 1.7.2.2 CNC
  - 1.7.2.3 Rapid Prototyping

Unit 2 The Magic of Electrons

Section 2.1 Science of Electricity
- 2.1.1 Matter
  - 2.1.1.1 Atoms
  - 2.1.1.2 Periodic Tables of Elements
  - 2.1.1.3 Sub-atomic particles
  - 2.1.1.3.1 Protons
  - 2.1.1.3.2 Neutrons
  - 2.1.1.3.3 Electrons
- 2.1.2 Conductors, Insulators and Semiconductors
- 2.1.3 Parts of the Atom
- 2.1.4 How Electrons Flow
- 2.1.5 Insulator, Conductors, Semiconductors

Section 2.2 Electromotive Force
- 2.2.1 Sources
  - 2.2.1.1 Mechanical
  - 2.2.1.2 Chemical
  - 2.2.1.3 Light
  - 2.2.1.4 Heat
- 2.2.2 Future Sources
  - 2.2.2.1 Fuel Cells

Section 2.3 Circuits Design
- 2.3.1 Types of Circuits
  - 2.3.1.1 Series
  - 2.3.1.2 Parallel
  - 2.3.1.3 Combination, Series/ Parallel
- 2.3.2 Schematics
  - 2.3.2.1 Symbols
  - 2.3.2.2 Diagrams
- 2.3.3 Ohm's Law
  - 2.3.3.1 Voltage
  - 2.3.3.2 Current
  - 2.3.3.3 Resistance
- 2.3.4 Electronic Devices
  - 2.3.4.1 Resistor
  - 2.3.4.2 Capacitor
  - 2.3.4.3 Diode, Light Emitting Diode
  - 2.3.4.4 Transistor
  - 2.3.4.5 Integrated Circuit

Section 2.4 Sensing
- 2.4.1 Sensors/Transducers
  - 2.4.1.1 Motion
  - 2.4.1.2 Force
  - 2.4.1.3 Light
  - 2.4.1.4 Temperature
  - 2.4.1.5 Sound
- 2.4.2 Analog/Circuits
  - 2.4.2.1 Amplification
  - 2.4.2.2 Comparison
- 2.4.3 Digital/Circuits
  - 2.4.3.1 Binary Number System
    - 2.4.3.1.1 Bits & Bytes
    - 2.4.3.1.2 ASCII Code
    - 2.4.3.1.3 Transistors as Switches
  - 2.4.3.2 Gates
    - 2.4.3.2.1 Inverter
    - 2.4.3.2.2 AND
    - 2.4.3.2.3 OR
    - 2.4.3.2.4 XOR

Section 2.5 Social Implications of Electronics
- 2.5.1 Career Investigations
- 2.5.2 Education Paths to Electronic Careers

Unit 3 The Science of Technology

Section 3.1 The Mechanics of Movement
- 3.1.1 Simple Machines
  - 3.1.1.1 Forces
  - 3.1.1.1.1 Gravity
  - 3.1.1.1.2 Weight
  - 3.1.1.1.3 Inertia

- 3.1.1.1.4 Friction
- 3.1.1.1.5 Torque
- 3.1.1.2 Motion
  - 3.1.1.2.1 Lineal
  - 3.1.1.2.2 Rotary
  - 3.1.1.2.3 Oscillating
  - 3.1.1.2.4 Reciprocating
- 3.1.1.3 Work
  - 3.1.1.3.1 Definition
  - 3.1.1.3.2 Power
  - 3.1.1.3.3 Efficiency
  - 3.1.1.3.4 Mechanical advantage

Section 3.2 Energy Conversion Systems

- 3.2.1 Forms of Energy
  - 3.2.1.1 Electrical
  - 3.2.1.2 Fluid Pressure
  - 3.2.1.3 Heat
  - 3.2.1.4 Light
  - 3.2.1.5 Chemical
  - 3.2.1.6 Sound
  - 3.2.1.7 Nuclear
- 3.2.2 Energy Resources
  - 3.2.2.1 Renewable
  - 3.2.2.2 Nonrenewable
  - 3.2.3 Conversion of Energy
    - 3.2.3.1 History of Power Generation
    - 3.2.3.2 Methods of Converting and Conserving Energy
    - 3.2.3.3 Impact on the Environment

Section 3.3 Communications

- 3.3.1 Light and Images
  - 3.3.1.1 Properties of Light
    - 3.3.1.1.1 Color
    - 3.3.1.1.2 Intensity
  - 3.3.1.2 Laser
  - 3.3.1.3 Photography
    - 3.3.1.3.1 Film Based
    - 3.3.1.3.2 Digital
- 3.3.2 Desktop Publishing
  - 3.3.2.1 Flat Bed Scanner
  - 3.3.2.2. Digital Camera
  - 3.3.2.3 Software
- 3.3.3 Sound
  - 3.3.3.1 Properties of Sound
  - 3.3.3.2 Production and Transmission
- 3.3.4 Telecommunications
  - 3.3.4.1 Modem
  - 3.3.4.2 Fax

Unit 4 Automation & Robotics

Section 4.1 Introduction

- 4.1.1 What is Robotics?
- 4.1.2 History of Robotics?
- 4.1.3 Future of Robotics?

Section 4.2 Structures

- 4.2.1 Comparisons
  - 4.2.1.1 Natural
  - 4.2.1.2 Man-made

- 4.2.2 Load Carrying Devices
  - 4.2.2.1 Beams and Girders
  - 4.2.2.2 Struts
  - 4.2.2.3 Ties
- 4.2.3 Forces
  - 4.2.3.1 Tension
  - 4.2.3.2 Compression
- 4.2.4 Stability
  - 4.2.4.1 Balance
  - 4.2.4.2 Mass

Section 4.3 Mechanics of Energy Transfer

- 4.3.1 Changing Direction and Force
  - 4.3.1.1 Worm Gear
  - 4.3.1.2 Universal Joint
  - 4.3.1.3 Bevel Gear
- 4.3.2 Changing Type of Movement
  - 4.3.2.1 Rack and Pinion
  - 4.3.2.2 Crank and Slider
  - 4.3.2.3 Cam and Follower
  - 4.3.2.4 Lead Screw
- 4.3.3 Transmitting Rotary Movement
  - 4.3.3.1 Belts and Pulleys
  - 4.3.3.2 Chains and Sprockets
  - 4.3.3.3 Gear Trains
- 4.3.4 Friction
  - 4.3.4.1 Bearing Surfaces
  - 4.3.4.2 Types of Bearings
  - 4.3.4.3 Lubrication

Section 4.4 Manufacturing Processes

- 4.4.1 Separating
  - 4.4.1.1 Sawing
  - 4.4.1.2 Drilling
  - 4.4.1.3 Milling
  - 4.4.1.4 Turning
  - 4.4.1.5 Grinding
  - 4.4.1.6 Electrical Discharge Machine
- 4.4.2 Forming
  - 4.4.2.1 Forging
  - 4.4.2.2 Casting
  - 4.4.2.3 Bending
  - 4.4.2.4 Extruding
  - 4.4.2.5 Hydro-forming
  - 4.4.2.6 Explosive Forming
  - 4.4.2.7 Stamping
  - 4.4.3 Combining
    - 4.4.3.1 Mechanical
    - 4.4.3.2 Heat
    - 4.4.3.3 Adhesive
    - 4.4.3.4 Interlocking
  - 4.4.4 Finishing
    - 4.4.4.1 Coating
    - 4.4.4.2 Anodizing
    - 4.4.4.3 Plating
    - 4.4.4.4 Laminating

Section 4.5 Control Systems

- 4.5.1 Types of Control Systems

- 4.5.1.1 Open Loop
- 4.5.1.2 Closed Loop

4.5.2 Sensors

- 4.5.2.1 Analog
  - 4.5.2.1.1 Temperature
  - 4.5.2.1.2 Light
  - 4.5.2.1.3 Sound
  - 4.5.2.1.4 Force
- 4.5.2.2 Digital
  - 4.5.2.2.1 Micro Switch
  - 4.5.2.2.2 Reed Switch
  - 4.5.2.2.3 Light
  - 4.5.2.2.4 Force

Section 4.6 Programming

4.6.1 Human to Machine

- 4.6.1.1 Flow Charting
  - 4.6.1.1.1 Task Evaluation
  - 4.6.1.1.2 Logical Thinking
- 4.6.1.2 Code Generation
  - 4.6.1.2.1 Graphical Interface
  - 4.6.1.2.2 Writing Code
  - 4.6.1.2.3 Automated Code Generation

4.6.2 Machine to Machine

- 4.6.2.1 Commands
- 4.6.2.2 Drivers Program
- 4.6.2.3 Interface connections
- 4.6.2.4 Power supplies
- 4.6.2.5 Diagnostic program

Section 4.7 Social Implications of automation and robotics

- 4.7.1 Career investigation
- 4.7.2 Education paths to technical/engineering careers

End of Gateway to Technology course outline

Principles of Engineering

Project Lead the Way ©, Troy, NY

Course Description & Outline

Principles of Engineering© - is a course that helps students understand the field of engineering/engineering technology. Exploring various technology systems and manufacturing processes help students learn how engineers and technicians use math, science and technology in an engineering problem solving process to benefit people. The course also includes concerns about social and political consequences of technological change.

Unit 1 Definition and Types of Engineering

- Section 1.1 Engineers as Problem Solvers
  - 1.1.1 Past, Present and Future
- Section 1.2 Engineering Team
- Section 1.3 Careers in Engineering
  - 1.3.1 Engineering
  - 1.3.2 Engineering Technology
  - 1.3.3 Distinction between Engineering and Engineering Technology

Unit 2 Communication and Documentation

- Section 2.1 Sketching
- Section 2.2 Technical Writing
  - 2.2.1 Engineer's Notebook
  - 2.2.2 Technical Reports
  - 2.2.3 Style
- Section 2.3 Data Representation and Presentation
- Section 2.4 Presentations

Unit 3 Design Process

- Section 3.1 Product Development
  - 3.1.1. Problem Identification
    - 3.1.1.1. Design Brief
  - 3.1.2. Problem Analysis
  - 3.1.3. Information Gathering
  - 3.1.4. Alternative Solutions and Optimization
  - 3.1.5. Modeling
  - 3.1.6. Testing and Evaluation
  - 3.1.7. Presentation of Solution

Unit 4 Engineering Systems

- Section 4.1 Mechanisms
  - 4.1.1. Mechanical Advantage
  - 4.1.2. Simple Machines
    - 4.1.2.1. Levers
    - 4.1.2.2. Inclined Plane
    - 4.1.2.3. Wedge
    - 4.1.2.4. Wheel and Axle
    - 4.1.2.5. Pulley
    - 4.1.2.6. Screw
  - 4.1.3. Gears
  - 4.1.4. Cams
  - 4.1.5. Linkages
- Section 4.2 Thermodynamics
  - 4.2.1 Units
  - 4.2.2 Forms of Energy
    - 4.2.2.1 Mechanical

- 4.2.2.2 Chemical
- 4.2.2.3. Electromagnetic
- 4.2.2.4. Nuclear
- 4.2.2.5. Thermal
- 4.2.2.6. Solar

4.2.3 Energy Conversion
4.2.4 Cycles
- 4.2.4.1 Open
- 4.2.4.2 Closed

4.2.5 Efficiency
4.2.6 Energy Loss
- 4.2.6.1. Conduction
- 4.2.6.2. Convection
- 4.2.6.3. Radiation

4.2.7 Heat Engines
- 4.2.7.1 Steam
- 4.2.7.2 Internal Combustion

4.2.7.3 Turbines

Section 4.3 Fluid Systems

4.3.1. Hydraulic Systems
- 4.3.1.1 Pascal's Law

4.3.1.2 Components
- 4.3.2. Pneumatic Systems
- 4.3.2.1 Boyle's Law
- 4.3.2.2 Components

Section 4.4 Electrical Systems

4.4.1. Electrical Theory
- 4.4.1.1. Sources of Electromotive Force
- 4.4.1.2. Ohms Law
- 4.4.1.3. Kirchhoff's Laws
- 4.4.1.4. Watt's Law

4.4.2. Metering Devices
4.4.3. Motors and Generators
- 4.4.3.1. DC Motor
  - 4.4.3.1.1. Permanent Magnet
  - 4.4.3.1.2. Electromagnet
  - 4.4.3.1.3. Components
- 4.4.3.2. DC Generator
- 4.4.3.3. AC Generator
  - 4.4.3.3.1. Single Phase
  - 4.4.3.3.2. Three Phase
- 4.4.3.4. AC Motor
  - 4.4.3.4.1. Synchronous
  - 4.4.3.4.2. Induction
- 4.4.3.5. Transformers
  - 4.4.3.5.1 Single Phase
  - 4.4.3.5.2. Multi-Phase
- 4.4.3.6. Electric Transmission Systems

Section 4.5 Control Systems

4.5.1. Open Loop System
4.5.2. Closed Loop System
- 4.5.2.1 Sensors and Actuators
- 4.5.2.2. Basic Concept of Automation, FMS and System Integration Programming
- 4.5.2.3 Flow Chart
- 4.5.2.4 PLC – Programmable Logic Control

Unit 5 Statics and Strength of Materials

- Section 5.1 Statics
  - 5.1.1 Strength of Shapes
  - 5.1.2 Forces
  - 5.1.3 Static Equilibrium
  - 5.1.4 Vectors
  - 5.1.5 Free body Diagrams
  - 5.1.6 Moments
  - 5.1.7 Reaction Forces
  - 5.1.8 Trusses
  - 5.1.9 Bridges
- Section 5.2 Strength of Materials
  - 5.2.1. Properties of Areas
    - 5.2.1.1. Center of Gravity
    - 5.2.1.2. Moments of Inertia
    - 5.2.1.3. Calculating Mass Properties Using CAE Tools
  - 5.2.2. Stress
  - 5.2.3. Strain
  - 5.2.4. Deflection

Unit 6 Materials and Materials Testing in Engineering

- Section 6.1 Categories of Materials
  - 6.1.1. Metals
  - 6.1.2. Alloys
  - 6.1.3. Nonmetals
  - 6.1.4. Composites
- Section 6.2 Properties of Materials
  - 6.2.1. Chemical Properties
  - 6.2.2. Physical Properties
  - 6.2.3. Mechanical Properties
  - 6.2.4. Dimensional Properties
- Section 6.3 Production Processes
- Section 6.4 Quality
  - 6.4.1 Engineering Statistics
  - 6.4.2 Precision Measurement Tools and Techniques
  - 6.4.3 Statistical Process Control
- Section 6.5 Material Testing Processes
  - 6.5.1. Nondestructive Inspection and Testing
  - 6.5.2. Destructive Testing

Unit 7 Engineering for Reliability

- Section 7.1 Reliability
  - 7.1.1. Determining Failure Rates
  - 7.1.2. Identifying Critical Components
  - 7.1.3 Redundancy
  - 7.1.4 Risk Analysis
  - 7.1.5 Factors of Safety
  - 7.1.6 Liability and Ethics
- Section 7.2 Case Study

Unit 8 Introduction to Dynamics/Kinematics

- Section 8.1 Linear Motion
  - 8.1.1. Displacement
  - 8.1.2. Velocity
  - 8.1.3 Acceleration
- Section 8.2 Trajectory Motion

End of Principles of Engineering course outline

Introduction to Engineering

Project Lead the Way ©, Troy, NY

Course Description & Outline

Introduction to Engineering Design© - is a course that teaches problem-solving skills using a design development process. Models of product solutions are created, analyzed and communicated using solid modeling computer design software.

Unit 1 Overview and Perspective of Design and Problem Solving Process

- Section 1.1 Evolution of Design and Drawing
  - 1.1.1 Chronology
  - 1.1.2 Acceleration of Change
  - 1.1.3 Future Applications
- Section 1.2 Relevancy and Career Opportunities
  - 1.2.1 Animation/Simulation
  - 1.2.2 Manufacturing
  - 1.2.3 Architectural/Engineering/Construction
  - 1.2.4 Geographical Information System
  - 1.2.5 Communications
  - 1.2.6 Entertainment
- Section 1.3 Human, Economic, and Environmental Impact
  - 1.3.1 Human
  - 1.3.1.1 Ergonomics
  - 1.3.1.2 Employability Skills
  - 1.3.1.3 Universal Language of Technology
  - 1.3.2 Economic
  - 1.3.2.1 Reduction of Product-to-Market Time
  - 1.3.2.2 Design Efficiency
  - 1.3.2.3 Accuracy/Improved Product Performance
  - 1.3.3 Ethical
  - 1.3.3.1 Environmental
  - 1.3.3.2 Social Responsibilities
- Section 1.4 Project/Product Development Process
  - 1.4.1 Identification of Need/Market Research
  - 1.4.2 Definition of Problem
  - 1.4.3 Research/Analysis of Problem
  - 1.4.4 List Solutions
  - 1.4.5 Select Solutions
  - 1.4.6 Project/Product Documentation
  - 1.4.7 Modeling and Prototyping
  - 1.4.8 Analysis and Evaluation
  - 1.4.9 Production and Continuous Improvement

Unit 2 Model Documentation

- Section 2.1 Documentation Basics
  - 2.1.1 Visualization
  - 2.1.2 Pictorial Sketching
  - 2.1.3 Annotated Sketching
- Section 2.2 Geometric Construction
  - 2.2.1 CAD Database
  - 2.2.2 Core Geometric Entities
  - 2.2.3 Geometric Relationships
  - 2.2.4 Creating 3-D Geometric Models and Solid Models
  - 2.2.5 Creating 2-D Models from 3-D Models
- Section 2.3 Annotating/Detailing Models
  - 2.3.1 Dimensioning

2.3.2 Tolerancing
2.3.3 Geometric Dimensioning & Tolerancing
Section 2.4 Detail Views
2.4.1 Sectional Views
2.4.2 Auxiliary Views
2.4.3 Working Drawings

Unit 3 Prototyping

Section 3.1 Traditional Prototyping
3.1.1 Handcrafted
3.1.2 CNC
Section 3.2 Rapid Prototyping
3.2.1 Polymer
3.2.2 Sintering
3.2.3 Paper
3.2.4 Monofilament
3.2.5 Other Processes
Section 3.3 Reverse Engineering
3.3.1 Digitizing
3.3.2 Coordinate Measuring Machine
3.3.3 Scanners

Unit 4 Analysis and Evaluation

Section 4.1 Boundary Element Analysis
Section 4.2 Eight Dimensions of Quality
4.2.1 Aesthetics/Appearance
4.2.2 Functionality/Performance
4.2.3 Reliability
4.2.4 Durability
4.2.5 Conformance to Standards
4.2.6 Serviceability
4.2.7 Features
4.2.8 Perceived Quality
Section 4.3 Safety
Section 4.4 Economics
Section 4.5 Environmental Considerations

Unit 5 Production & Continuous Improvement

Section 5.1 CAM/CNC
5.1.1 Post Processing
5.1.2 CNC Machining Processes
5.1.3 Other CNC Processes
Section 5.2 Automation
5.2.1 Robotics
5.2.2 Automated Assembly
5.2.3 Automated Inspection
Section 5.3 Continuous Improvement
5.3.1 Real-Time Inspection
5.3.2 Real-Time Adjustments
5.3.3 Customer Feedback
5.3.4 Corrective Actions

End of Introduction to Engineering course outline

Digital Electronics

Project Lead the Way ©, Troy, NY

Course Description & Outline

Digital Electronics© - is a course in applied logic that encompasses the application of electronic circuits and devices. Computer simulation software is used to design and test digital circuitry prior to the actual construction of circuits and devices.

Unit 1 Fundamentals
- Section 1.1 Safety
- Section 1.2 Basic Electron Theory
- Section 1.3 Prefixes, Engineering Notation
- Section 1.4 Resistors
- Section 1.5 Laws
- Section 1.6 Capacitance
- Section 1.7 Analog and Digital Waveforms
- Section 1.8 Obtaining Data Sheets

Unit 2 Number Systems
- Section 2.1 Conversions

Unit 3 Gates
- Section 3.1 Logic Gates

Unit 4 Boolean Algebra
- Section 4.1 Boolean Expressions
- Section 4.2 Logic Simplifications
- Section 4.3 Duality of Logic Functions

Unit 5 Combinational Circuit Design
- Section 5.1 Paradigm for Combinational Logic Problems
- Section 5.2 Specific Application MSI Gates
- Section 5.3 Programmable Logic Devices (PLD)

Unit 6 Adding
- Section 6.1 Binary Addition

Unit 7 Flip - Flops
- Section 7.1 Introduction to Sequential Logic
- Section 7.2 The J-K Flip-Flop
- Section 7.3 Triggers
- Section 7.4 Flip-Flop Timing Considerations
- Section 7.5 Elementary Applications of Flip-Flops

Unit 8 Shift Registers and Counters
- Section 8.1 Shift Registers
- Section 8.2 Asynchronous Counters
- Section 8.3 Synchronous Counters

Unit 9 Families and Specifications
- Section 9.1 Logic Families
- Section 9.2 Spec Sheets

Unit 10 Microprocessors
- Section 10.1 Microcontrollers
- Section 10.2 Interfacing with Motors

Unit 11 Student Directed Study Topic
- Section 11.1 Design Paradigm

End of Digital Electronics course outline

Computer Integrated Manufacturing

Project Lead the Way ©, Troy, NY

Course Description & Outline

Computer Integrated Manufacturing© - is a course that applies principles of robotics and automation. The course builds on computer solid modeling skills developed in Introduction to Engineering Design, and Design and Drawing for Production. Students use CNC equipment to produce actual models of their three-dimensional designs. Fundamental concepts of robotics used in automated manufacturing, and design analysis are included.

Unit 1 Computer Modeling

- Section 1.1 Fundamentals
- Section 1.2 2 D Object Construction
- Section 1.3 Parts Modeling
- Section 1.4 Creation of Drawings Views
- Section 1.5 Assembly Modeling
- Section 1.6 Surface Modeling
- Section 1.7 Prototyping

Unit 2 CNC Machining

- Section 2.1 History of Programmable Machining
- Section 2.2 CNC Characteristics
- Section 2.3 CNC Programming
- Section 2.4 CNC Operation
- Section 2.5 CAM Software

Unit 3 Robotics

- Section 3.1 Introduction to Robotics
- Section 3.2 Robotics and Automated Systems
- Section 3.3 Robot Characteristics
- Section 3.4 Robot Controllers
- Section 3.5 Programming the Robot
- Section 3.6 End Effectors
- Section 3.7 Robot Applications

Unit 4 Computer Integrated Manufacturing

- Section 4.1 Rationale for CIM Manufacturing
- Section 4.2 Types of CIM Systems
- Section 4.3 Components of CIM Systems
- Section 4.4 CIM System Applications

End of Computer Integrated Manufacturing course outline

Engineering Design and Development

Project Lead the Way ©, Troy, NY

Course Description & Outline

Engineering Design and Development© - An engineering research course in which students work in teams to research, design and construct a solution to an open-ended engineering problem. Students apply principles developed in the four preceding courses and are guided by a community mentor. They must present progress reports, submit a final written report and defend their solutions to a panel of outside reviewers at the end of the school year.

Unit 1 Introduction to Engineering Design and Development

- Section 1.1 Justification of Course/Project
  - 1.1.1. Syllabus/Scope and Sequence
  - 1.1.2 Testimonials/Previous Projects
  - 1.1.3 Getting Beyond the Book Report
- Section 1.2 Course Expectations
  - 1.2.1 Structure and Grading of Projects
    - 1.2.1.1 Instructor Evaluation/Student Evaluation
    - 1.2.1.2 Levels of Performance
    - 1.2.1.3 Presentation of Rubrics
  - 1.2.2 Final Presentation
  - 1.2.3 Student Resume
  - 1.2.4 Student Portfolio

Unit 2 Elements of Formal Research

- Section 2.1 Daily Research Journal
  - 2.1.1 Documenting the Process
    - 2.1.1.1 Sketches, Renderings, Pictures
    - 2.1.1.2 Working Drawings
    - 2.1.1.3 Technical Data
    - 2.1.2 Source Information
  - 2.1.2 Contacts
    - 2.1.2.1 Contact Log
    - 2.1.2.2 Record Source Information
    - 2.1.2.3 Thoughts/Note Cards/Quotes
- Section 2.2 Conventional Resources
  - 2.2.1 Reader's Guide to Periodicals
  - 2.2.2 General References
  - 2.2.3 Inter Library Loan
  - 2.2.4 Microfiche, Vertical File Catalog
  - 2.2.5 Librarians as a resource
- Section 2.3 Using the Computer as a Research Tool
  - 2.3.1 Internet
  - 2.3.2 Search Engines
    - 2.3.2.1 Search Strategies
  - 2.3.3 On-Line Databases
    - 2.3.3.2 Academic
    - 2.3.3.3 Government Resources
    - 2.3.3.4 People Searches
    - 2.3.3.5 Patent Searching
    - 2.3.3.6 Business Search
  - 2.3.4 E-Mail
    - 2.3.4.1 Setting Up an Account/Configuring the Program
    - 2.3.4.2 Person to Person Communication

Section 2.4 Contacting the Experts
- 2.4.1 Interpersonal Communication Skills
- 2.4.2 Phone Skills
- 2.4.3 Business Letter
- 2.4.4 Personal Interviewing Skills
- 2.4.5 Thank you letters

Unit 3 Guided Research

Section 3.1 Topics for Research
- 3.1.1 Methods of Brainstorming
- 3.1.2 Introduce Topic Area

Section 3.2 Gaining the Knowledge
- 3.2.1 Research the Topic
- 3.2.2 Gathering Information to Define Your Topic
  - 3.2.2.1 Identify Related Terminology and Concepts
  - 3.2.2.2 History of your Topic
  - 3.2.2.3 Relative Current Events
- 3.2.3 Summation of Information Gathered

Section 3.3 How To Write A Problem Statement
- 3.3.1 Problem Statement Activity
- 3.3.2 Developing Specifications and Constraints
- 3.3.3 Decision Matrix
- 3.3.4 Justification of Problem Statement

Section 3.4 Researching Alternative Solutions
- 3.4.1 Make complete list of all solutions past and present and justify them
- 3.4.2 Advantages and Disadvantages Matrix of each solution

Section 3.5 Developing Alternative Solutions
- 3.5.1 Make one alternative better
- 3.5.2 Combing Alternatives
- 3.5.3 Entire new Alternative
- 3.5.4 Select the most viable alternative

Section 3.6 Redefining and Justifying The Alternative Solutions
- 3.6.1 Is it original?
  - 3.6.1.1 Does the alternative have merit?
  - 3.6.1.2 Collecting Professional Opinions
  - 3.6.1.3 Surveys
- 3.6.2 Is a prototype possible?

Section 3.7 Presentation Methods
- 3.7.1 Multi-Media
  - 3.7.1.1 PowerPoint Presentations
  - 3.7.1.2 Slide Photography
  - 3.7.1.3 Transparencies
  - 3.7.1.4 Modeling and Demonstration Considerations
  - 3.7.1.5 Video and Audio Recording Techniques
- 3.7.2 Developing Presentations
- 3.7.3 Presenting Your Findings

Unit 4 Independent Research

Section 4.1 Expectations for Independent Research
- 4.1.1 Progress Report
- 4.1.2 Obtaining Materials
- 4.1.3 Time Management
- 4.1.4 Independent Research
  - 4.1.4.1 Brainstorming
  - 4.1.4.2 Narrow Problem Focus
  - 4.1.4.3 Writing Problem Statement
  - 4.1.4.4 Researching Alternative Solutions

- 4.1.4.5 Developing Alternative Solutions
- 4.1.4.6 Redefining and Justifying Alternative Solutions

Section 4.2 Developing The Prototype

- 4.2.1 Prototyping Methods
  - 4.2.1.1 Drafting or Concept Modeling
  - 4.2.1.2 Evaluate Gathered Materials
  - 4.2.1.3 Construction of Prototype
    - 4.2.1.3.1 Safety, Tools, Labs and Equipment
- 4.2.2 Test Prototype
  - 4.2.2.1 Professional Opinions
  - 4.2.2.2 Qualitative and Quantitative Field Testing
  - 4.2.2.3 Evaluating the Data for Validity
- 4.2.3 Improving the Design
  - 4.2.3.1 Redefine Constraints and Specifications
  - 4.2.3.2 List Modifications
  - 4.2.3.3 Implement Modifications

Section 4.3 Research Paper

- 4.3.1 Research and Writing
- 4.3.2 Mechanics of Writing
- 4.3.3 Format of a Technical Research Paper
- 4.3.4 Documentation of Sources

Unit 5 Formal Presentation

Section 5.1 Formal Presentations

- 5.1.1 Review Grading Procedures
- 5.1.2 Evaluation Panel
- 5.1.3 Delivery of Presentation
- 5.1.4 Feedback
- 5.1.5 Prepare Final Documents

End of Engineering Design and Development course outline

B. Exploring Technology Careers Program

The *Exploring Technology Careers* program is designed to give students an opportunity to explore and discover their interest and potential in one or more career clusters. Students begin their journey in the middle school course, *Invention & Innovation*, where they apply the design process in the invention or innovation of a new product. Students will have an opportunity to study the history of inventions and innovations, including their impacts on society.

At the freshman level, students will have the opportunity to explore in breadth, three different career clusters each semester. Academic knowledge and skills along with technical knowledge and skills needed to be successful in each pathway will be investigated. Students at the sophomore level will be able to continue to develop their skills and knowledge in one or more career clusters. Successful completion of the *Exploring Technology Careers* program will allow students to enter a career specific occupational program during the junior and senior years with confidence. In turn, successful completion of a career education program will lead to readiness for postsecondary career and technical programs. The *Exploring Technology Careers* program will be eligible for Career Education program approval in 2005.

The *Exploring Technology Careers* course along with the six cluster specific courses will provide opportunity for students to:

- Explore various technical skills and academic requirements for a given career cluster and occupations within that cluster.
- Develop basic occupational skills within the allotted time.
- Participate in hands-on activities in the given career cluster and occupations that allow for both individual and team efforts.
- Complete evaluations for basic skills within each career cluster and occupation explored through written and performance assessments.

The *Exploring Technology Careers* course along with the six cluster specific courses will also provide opportunities for students to further develop their knowledge and skills in the academic and technical areas listed below.

Communications

- Use reading strategies to learn meaning, technical concepts, vocabulary, and to bring together information needed for a particular situation.
- Locate, organize, and document written information.
- Use correct grammar, punctuation and terminology to write and edit documents.
- Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences.
- Apply active listening skills to obtain and clarify information.
- Interpret and use information in tables, charts, and figures to support written and oral communications.

Problems Solving & Critical Thinking

- Formulate solutions to problems using critical thinking skills while working independently and/or in teams.

Information Technology Applications

- Use electronic mail applications, Internet applications, writing/publishing applications, presentation applications, spreadsheet applications, computer operations applications and computer-based equipment (containing embedded computers or processors used to control electromechanical devices).

Systems

- Use knowledge of how businesses in various careers operate.

Safety, Health & Environmental

- Use safety and health knowledge within career environments.

Leadership & Teamwork

- Apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

Ethics & Legal Responsibilities

- Demonstrate knowledge of and commitment to professional ethics and legal responsibilities.

Employability & Career Development

- Demonstrate positive work behaviors and personal qualities.
- Develop a personal career plan to meet career goals and objectives.
- Demonstrate ability to seek and apply for employment.

Technical Skills

- Demonstrate understanding of the basic technical skills and knowledge required in various careers.

Exploring Technology Careers Program

Invention & Innovation

Course Description & Outline

(Middle School)

Invention & Innovation – is a course that provides students with the opportunities to apply the design process in the invention or innovation of a new product, process, or system. Students will have the opportunity to study the history of inventions and innovations, including their impacts on society. They will learn about the core concepts of technology, and about the various approaches to solving problems, including engineering design and experimentation.

Standards Addressed

The *Standards for Technological Literacy*© which can be addressed in this course are:

Standard 1	Standard 2	Standard 3	Standard 4	Standard 6
Standard 7	Standard 8	Standard 9	Standard 10	Standard 11
Standard 12	Standard 13	Standard 14	Standard 15	Standard 17
Standard 18	Standard 20			

The *Missouri Show-Me Performance Standards* which can be address in this course are:

Goal 1.1	Goal 1.2	Goal 1.4	Goal 1.5	Goal 1.7
Goal 1.8	Goal 1.10	Goal 2.1	Goal 2.2	Goal 2.3
Goal 2.5	Goal 2.7	Goal 3.1	Goal 3.2	Goal 3.3
Goal 3.4	Goal 3.5	Goal 3.6	Goal 3.7	Goal 3.8
Goal 4.1	Goal 4.3	Goal 4.4	Goal 4.5	Goal 4.6
Goal 4.7				

The *Missouri Show-Me Knowledge Standards* which can be address in this course are:

In Communication Arts:	CA 1	CA 3	CA 4	CA 5	CA 6
In Fine Arts:	FA 1	FA 2	FA 4	FA 5	
In Health/Physical Education:		H 6	H 7		
In Mathematics:	M 1	M 2	M 4	M 6	
In Science:	S 2	S 6	S 7	S 8	

Unit 1 Introduction

1.1 Definitions
1.2 Scope of Technology
1.3 Society Influences Technology & Technology Influences Society
1.4 History of Technology
1.5 Design
1.6 Engineering Design
1.7 Famous Inventors and Their Inventions

Unit 2 Core Concepts of Technology

- 2.1 Systems
- 2.2 Common Systems Found in a Technology
- 2.3 Designed World
- 2.4 Systems and Subsystems of the Transportation and Construction

Unit 3 Problems Solving: Design, Troubleshooting, Research and Development And Experimentation

- 3.1 Design
- 3.2 Design – A problem Solving Approach
- 3.3 Engineering Design
- 3.4 Troubleshooting
- 3.5 Research and Development
- 3.6 Experimentation

Unit 4 Let's Invent and Innovate!

- 4.1 Becoming an Inventor or Innovator – Prerequisite knowledge
- 4.2 What Does it Take to be an Inventor or Innovator?
- 4.3 Invention and Innovation – Where do we Start?
- 4.4 Inventor's Notebook
- 4.5 The Invention and Innovation Process
- 4.6 Protecting Your Invention or Innovation
- 4.7 Marketing an Invention or Innovation

Unit 5 Impacts of Invention and Innovation

- 5.1 Invention and Innovation Affect Society
- 5.2 Invention and Innovation Affect Humans
- 5.3 Technology and the Environment
- 5.4 Using Data to Make Informed Decisions
- 5.5 Innovations and Inventions

End of Invention & Innovation course outline

Exploring Technology Careers A & B
Course Descriptions & Outline
(Two One-Semester Courses)

Exploring Technology Careers A & B (two, one semester courses) – are semester courses that explore career opportunities available through Missouri Career Education (formally Missouri Vocational Education) and postsecondary education by participation in each of two one-semester courses. Through contextual hands-on learning students will have the possibility to explore career occupations in three of the following Career Clusters each semester. For clarification, the current Missouri Career Paths are shown in parenthesis to indicate a crosswalk to the States' Career Clusters:

- Architecture & Construction (Arts & Communications/Industrial & Engineering Technology)
- Audio Visual Technology & Communication (Arts & Communications)
- Information Technology (Business, Management, & Technology)
- Manufacturing (Industrial & Engineering Technology)
- Science, Technology, Engineering & Mathematics (Industrial & Engineering Technology)
- Transportation, Distribution & Logistics (Industrial & Engineering Technology)

Upon successful completion of these courses, students will be encouraged to and be capable of selecting a specific career cluster course which will allow in-depth experiences and study of occupations within the chosen career cluster. A program of study which leads to desired entry level occupations or post-secondary career education will be developed at the completion of the career cluster course(s). The career occupational choices will be based on interest and basic abilities discovered through a formal interest search and hands-on experiences.

Standards Addressed (See Appendix for full description of Standards)
The *Standards for Technological Literacy*© which can be addressed in this course are:

Standard 4	Standard 9	Standard 10	Standard 11	Standard 12
Standard 13	Standard 16	Standard 17	Standard 18	Standard 19
Standard 20				

The *Missouri Show-Me Performance Standards* which can be address in this course are:

Goal 1.1	Goal 1.2	Goal 1.4	Goal 1.5	Goal 1.8
Goal1.10	Goal 2.1	Goal 2.5	Goal 2.7	Goal 3.1
Goal 4.4	Goal 4.5	Goal 4.6	Goal 4.7	Goal 4.8

The *Missouri Show-Me Knowledge Standards* which can be address in this course are:

In Communication Arts:	CA 1	CA 3	CA 4	CA 5	CA 6
In Health/Physical Education:	H 6	H 7			
In Mathematics:	M 1	M 2			
In Science:	S 8				

Student Outcomes
In each semester course, students will have the opportunity to select and explore three different career clusters. Students will research each career cluster and more specifically career occupations (or pathways) to discover the following:

- job descriptions
- academic and technical knowledge & skill requirements
- education path
- work environment
- wage/salary outlook
- job availability outlook

More specifically, at the successful completion of each semester course, the student will have:

- completed a self-awareness survey and will have identified a range of career areas (career clusters and occupations) related to their interests.
- investigated in-depth at least three occupations (per semester) related to technology and associated with self awareness findings through the completion of each semester course.
- gained awareness and understanding of the technical skills and academic requirements for each of their career areas of interest.
- explored current technological tools and processes in addition to related safety practices in the career areas studied by the student.
- completed job shadowing and/or shadowing of a student enrolled in advanced career education courses in one or more areas of interest.

Unit 1 Career Cluster Search

Section 1.1 Occupation description(s)
- 1.1.1 Types of tasks performed
- 1.1.2 Working conditions
- 1.1.3 Possible job locations
- 1.1.4 Earning possibility
- 1.1.5 Skill requirements
  - 1.1.5.1 Technical
  - 1.1.5.2 Academic
  - 1.1.5.2.1 Math
  - 1.1.5.2.2 Science
  - 1.1.5.2.3 Language arts
- 1.1.6 Safety knowledge
- 1.1.7 Minimum education requirements

Section 1.2 Experience typical job tasks
- 1.2.1 Complete project(s) that incorporates use of typical skills and academic functions
- 1.2.2 Complete project(s) that include typical materials, tools, and equipment found in career occupation

Section 1.3 Practice safety expected in career/occupation
- 1.3.1 Safe use of tools and equipment
- 1.3.2 Typical safety practice in career environment

Section 1.4 Gain understanding of and exposure to Career Education course offerings

1.4.1 Research and visit programs offered at local high school/career center
1.4.2 Research and visit courses offered at local community college and/or private technical school

Unit 2 Hands-on Project(s)

Section 2.1 Processes
Section 2.2 Materials
Section 2.3 Tools/equipment
Section 2.4 Hands-on technical skills experience
Section 2.5 Academic skills experience

Unit 3 Professional Contacts

Section 3.1 Interview(s) with professional(s)
- 3.1.1 Contacting professional(s)
  - 3.1.1.1 Letter contact
  - 3.1.1.2 Telephone contact
  - 3.1.1.3 E-mail contact
  - 3.1.1.4 In-person contact
- 3.1.2 Interview process
- 3.1.3 Report
  - 3.1.3.1 Written report
  - 3.1.3.2 Oral report

Section 3.2 Student Mentor
- 1.2.1 Selection of student mentor
- 1.2.2 Mentor visit
- 1.2.3 Mentor/Student interview
- 1.2.4 Mentor/Student shadow

Unit 4 Capstone Experience (Scenario)

Students should have "capstone" experiences that allow them to explore a major component of the Career Cluster/Occupation.

Section 4.1 Introduction Summary
- 4.1.1 Objectives of Capstone Experience
- 4.1.2 Safety information
- 4.1.3 Time Line
- 4.1.5 Mathematics requirements
- 4.1.6 Science knowledge requirements
- 4.1.7 Activity Reports
- 4.1.8 Materials required
- 4.1.9 Tools/equipment required
- 4.1.10 Supplies required
- 4.1.11 Assessment of capstone experience
  - 4.1.11.1 Scoring guide

Unit 5 Assessment

Section 5.1 Interest Inventory
Section 5.2 Career Cluster/Occupation Information

End of Exploring Technology Careers course outline

Exploring Architecture & Construction
Course Description & Outline

Exploring Architecture & Construction - is a course that allows students opportunity to explore careers in the architectural and construction fields by investigating occupations in this cluster, experiencing typical occupational hands-on activities, gaining basic knowledge and developing basic technical skills which will prepare them for future career courses in one or more occupations.

Standards Addressed (See Appendix for full description of Standards)

The *Standards for Technological Literacy*© which can be addressed in this course are:

Standard 7 Standard 8 Standard 9 Standard 11 Standard 12
Standard 16 Standard 20

The *Missouri Show-Me Performance Standards* which can be address in this course are:

Goal 1.1 Goal 1.2 Goal 1.4 Goal 1.5 Goal 1.8
Goal 1.10 Goal 2.1 Goal 2.5 Goal 2.7 Goal 3.1
Goal 4.4 Goal 4.5 Goal 4.6 Goal 4.7 Goal 4.8

The *Missouri Show-Me Knowledge Standards* which can be address in this course are:

In Communication Arts: CA 1 CA 3 CA 4 CA 5 CA 6

In Fine Arts: FA 1 FA 2 FA 4 FA 5

In Health/Physical Education: H 6 H 7

In Mathematics: M 1 M 2

In Science: S 8

Unit 1 Introduction to Architecture & Construction Careers

- 1.1 What is architecture?
  - 1.1.1 Architecture defined
  - 1.1.2 Types of architecture
- 1.2 What is construction?
  - 1.2.1 Construction defined
  - 1.2.2 Types of construction
- 1.3 What occupations can be found in architecture & construction?
  - 1.3.1 Design/Pre-Construction
    - 1.3.1.1 Designer
      - 1.3.1.1.1 Architect
      - 1.3.1.1.2 Landscape
      - 1.3.1.1.3 Regional & Urban Planner/Designer
      - 1.3.1.1.4 Interior
      - 1.3.1.1.5 Other
    - 1.3.1.2 Engineer
      - 1.3.1.2.1 Architectural
      - 1.3.1.2.2 Civil
      - 1.3.1.2.3 Electrical
      - 1.3.1.2.4 Environmental
      - 1.3.1.2.5 Mechanical
      - 1.3.1.2.6 Fire Prevention and Protection

1.3.1.2.7 Other
1.3.1.3 Technician
1.3.1.3.1 Surveyor
1.3.1.3.2 Architectural/Civil Drafter
1.3.1.3.3 Engineering
1.3.1.3.4 Modeler
1.3.1.3.5 Other
1.3.1.4 Other
1.3.1.4.1 Specifications Writer
1.3.1.4.2 Building Code Official
1.3.1.4.3 Cost Estimator
1.3.1.4.4 Other
1.3.1.5 Other
1.3.2 Construction
1.3.2.3.1 General Contractor
1.3.2.3.1.1 Construction Manager
1.3.2.3.1.2 Superintendent
1.3.2.3.1.3 Project Manager
1.3.2.3.1.4 Construction Foreman
1.3.2.3.1.5 Scheduler
1.3.2.3.1.6 Field Supervisor
1.3.2.3.1.7 Project Inspector
1.3.2.3.1.8 Estimator
1.3.2.3.1.9 Other
1.3.2.3.2 Sales and Marketing
1.3.2.3.2.1 Manager
1.3.2.3.2.2 Service Contractor
1.3.2.3.2.3 Other
1.3.2.3.3 Technician/Trades
1.3.2.3.3.1 Carpenter
1.3.2.3.3.2 Mason
1.3.2.3.3.3 Iron/Metalworker
1.3.2.3.3.4 Electrician
1.3.2.3.3.5 Boilermaker
1.3.2.3.3.6 Concrete
1.3.2.3.3.7 Plaster/Drywall
1.3.2.3.3.8 Plumbing
1.3.2.3.3.9 Mechanical
1.3.2.3.3.10 Millwright
1.3.2.3.3.11 Installers
1.3.2.3.5 Other
1.3.3 Maintenance/Operations
1.3.3.1 General Maintenance Contractor
1.3.3.2 Sales and Marketing
1.3.3.2.1 Manager
1.3.3.2.2 Service Contractor
1.3.3.2.3 Manufacturer's Representative
1.3.3.2.4 Other
1.3.3.3 Technician/Trades
1.3.3.4 Other
1.4 How is architecture & construction organized?
1.4.1 Design/Engineering
1.4.2 Marketing
1.4.3 Finance
1.4.4 Construction
1.4.5 Management

1.4.6 Maintenance

1.5 Investigating specific occupations
- 1.5.1 What are the working conditions of this occupation?
- 1.5.2 What education do you need for this occupation?
- 1.5.3 What is the salary range for this occupation?
- 1.5.4 What is the long-range outlook for this occupation?
- 1.5.5 What technical skills must you have for this occupation?
- 1.5.6 What academic skills must you have for this occupation?

1.6 Interviewing the professional
- 1.6.1 Identifying professionals in the occupation
- 1.6.2 Corresponding with the professional
- 1.6.3 Interview with professional
  - 1.6.3.1 Telephone interview
  - 1.6.3.2 E-mail interview
  - 1.6.3.3 Face-to-Face interview

Unit 2 Exploring academic skills for architecture & construction

2.1 Applied communications in architecture and construction
- 2.1.1 Using written, verbal, and visual communication techniques consistent with industry standards

2.2 Applied mathematics in architecture and construction
- 2.2.1 Using mathematics concepts in architecture and construction technology

2.3 Applied science in architecture and construction
- 2.3.1 Using scientific principles in architecture and construction technology

2.4 Applied measurement techniques in architecture and construction
- 2.4.1 Using appropriate measuring techniques found in architecture and construction

Unit 3 Exploring personal skills for architecture and construction

3.1 Teamwork
- 3.1.1 How to work as a team member
- 3.1.2 Using teamwork to solve problems

3.2 Leadership
- 3.2.1 Identify characteristics of good leader
- 3.2.2 Identify different roles between team leader and team member
- 3.2.3 Use leadership skills in architecture and construction projects

3.3 Organizational skills
- 3.3.1 Use time management techniques for work schedules and deadlines

3.4 Integrity, Honesty, Work Habits
- 3.4.1 Match employers' expectations with appropriate work habits
- 3.4.2 Identify discrimination and harassment characteristics in the work place

3.5 Problem solving, critical thinking, and decision making related to architecture and construction
- 3.5.1 Develop and apply process for problem solving in architecture and construction
- 3.5.2 Develop and apply critical thinking strategies to analyze and evaluate architecture and construction solutions

Unit 4 Exploring technical skills for architecture and construction

4.1 Use a design process to develop a design solution for a client

4.1 Use computer-aided-design systems to produce design and construction documents

4.2 Use construction tools, equipment, and machines to safely construct designed structure

4.3 Read, interpret, and modify, as needed, construction documents

Unit 5 Develop an architectural design project

5.1 Design process
- 5.1.1 Apply design process to solve architectural problem
- 5.1.2 Use appropriate technical reference materials to solve architectural problem

5.2 Produce architectural presentation documents
- 5.2.1 Present to client
- 5.2.2 Incorporate design changes

5.3 Produce architectural construction documents
- 5.3.1 Develop architectural plans
- 5.3.2 Use local building codes
- 5.3.3 Use plan check procedures

5.4 Maintain architectural tools, equipment, and resources
- 5.4.1 Maintain CAD system
- 5.4.2 Maintain reproduction system
- 5.4.3 Maintain resource/reference system

5.5 Establish architectural management (program of work) system
- 5.5.1 Develop plan to complete architectural project
  - 5.5.1.1 Personnel
  - 5.5.1.2 Facilities
  - 5.5.1.3 Finance
  - 5.5.1.4 Other

5.6 Apply appropriate codes, laws, standards, or regulations to architectural procedures
- 5.6.1 Architectural Graphic Standards
- 5.6.2 Building Codes
  - 5.6.2.1 National building codes
  - 5.6.2.2 Local
- 5.6.3 National Electrical Code (NEC)
- 5.6.4 National Mechanical Code (NMC)
- 5.6.5 National Plumbing Code (NPC)
- 5.6.6 Other

5.7 Evaluate construction project
- 5.7.1 Record keeping

Unit 6 Develop a construction project

6.1 Selecting appropriate resources
- 6.1.1 Architectural construction documents
- 6.1.2 Building permits
  - 6.1.2.1 Excavation
  - 6.1.2.2 Foundation
  - 6.1.2.3 Framing
  - 6.1.2.4 Electrical
  - 6.1.2.5 Plumbing
  - 6.1.2.6 Mechanical
  - 6.1.2.7 Insulation
  - 6.1.2.8 Finish
- 6.1.3 Selecting and using appropriate tools, equipment, machines, materials, and technical processes
  - 6.1.3.1 Excavation
  - 6.1.3.2 Foundation
  - 6.1.3.3 Framing
  - 6.1.3.4 Electrical
  - 6.1.3.5 Plumbing
  - 6.1.3.6 Mechanical
  - 6.1.3.7 Insulation
  - 6.1.3.8 Finish

6.2 Establish management and supervision system for construction project
- 6.2.1 Develop program of work
  - 6.2.1.1 Time line
- 6.2.2 Establish construction budget

6.3 Evaluate construction project
- 6.3.1 Record keeping

End of Exploring Architecture & Construction course outline

Exploring Communications Technology
Course Description & Outline

Exploring Communications Technology - is a course that allows students opportunity to explore careers in the communications technology field by investigating occupations in this cluster, experiencing typical occupational hands-on activities, gaining basic knowledge and developing basic technical skills which will prepare them for future career courses in one or more occupations.

Standards Addressed (See Appendix for full description of Standards)

The *Standards for Technological Literacy*© which can be addressed in this course are:

Standard 7 Standard 8 Standard 9 Standard 11 Standard 12 Standard 17

The *Missouri Show-Me Performance Standards* which can be address in this course are:

Goal 1.1 Goal 1.2 Goal 1.4 Goal 1.5 Goal 1.8
Goal 1.10 Goal 2.1 Goal 2.5 Goal 2.6 Goal 2.7
Goal 3.1 Goal 4.4 Goal 4.5 Goal 4.6 Goal 4.7
Goal 4.8

The *Missouri Show-Me Knowledge Standards* which can be address in this course are:

In Communication Arts: CA 1 CA 3 CA 4 CA 5 CA 6

In Fine Arts: FA 1 FA 2 FA 4

In Health/Physical Education: H 6 H 7

In Mathematics: M 1 M 2

In Science: S 8

Unit 1 Introduction to Communications Technology Careers

- 1.2 What is Communications Technology?
  - 1.1.1 Defined
  - 1.1.2 Types of communications technology
- 1.2 What occupations can be found in communications technology?
  - 1.2.1 Audio & Video Technology & Film
    - 1.2.1.1 Video system technician
    - 1.2.1.2 Video graphics, special effects, animation
    - 1.2.1.3 Audio systems technician
    - 1.2.1.4 Technical computer support technician
    - 1.2.1.5 Other
  - 1.2.2 Printing Technology
    - 1.2.2.1 Graphic & printing equipment operator
    - 1.2.2.2 Lithographer & platemaker
    - 1.2.2.3 Computer typographer & composition equipment operator
    - 1.2.2.4 Desktop publishing specialist, web page designer
    - 1.2.2.5 Other
  - 1.2.3 Visual Arts
    - 1.2.3.1 Commercial photographer
    - 1.2.3.2 Interior designer

1.2.3.3 Graphic designer
1.2.3.4 CAD technician
1.2.3.5 Other

1.2.4 Performing Arts
1.2.4.1 Production manager, digital, video, stage
1.2.4.2 Cinematographer, film/video editors
1.2.4.3 Stagecraft designer, lighter, sets, sound effects, acoustics
1.2.4.4 Other

1.2.5 Broadcasting
1.2.5.1 Audio/Video operations
1.2.5.2 Control room technician
1.2.5.3 Station manager, radio/TV announcers
1.2.5.4 Broadcast technician
1.2.5.5 Other

1.2.6 Telecommunications
1.2.6.1 Telecommunication technician
1.2.6.2 Telecommunication equipment, cable, line repairer/installer
1.2.6.3 Telecommunication computer programmer & systems analyst
1.2.6.4 Other

1.3 How is communications technology organized?
1.3.1 Audio & Video Technology and Film
1.3.2 Printing Technology
1.3.3 Visual Arts
1.3.4 Performing Arts
1.3.5 Broadcasting
1.3.6 Telecommunications

1.4 Investigating specific occupations
1.4.1 What are the working conditions of this occupation?
1.4.2 What education do you need for this occupation?
1.4.3 What is the salary range for this occupation?
1.4.4 What is the long-range outlook for this occupation?
1.4.5 What technical skills must you have for this occupation?
1.4.6 What academic skills must you have for this occupation?

1.5 Interviewing the professional
1.5.1 Identifying professionals in the occupation
1.5.2 Corresponding with the professional
1.5.3 Interview with professional
1.5.3.1 Telephone interview
1.5.3.2 E-mail interview
1.5.3.3 Face-to-Face interview

Unit 2 Exploring academic skills for communications technology

2.5 Applied communications in communications technology
2.5.1 Using written, verbal, and visual communication techniques consistent with industry standards

2.6 Applied mathematics in communications technology
2.6.1 Using mathematics concepts in communications technology

2.7 Applied science in communications technology
2.7.1 Using scientific principles in communications technology

2.8 Applied measurement techniques in communications technology
2.8.1 Using appropriate measuring techniques found in communications technology

Unit 3 Exploring personal skills for communications technology

3.5 Teamwork
3.5.1 How to work as a team member
3.5.2 Using teamwork to solve problems

3.6 Leadership

3.6.1 Identify characteristics of good leader
3.6.2 Identify different roles between team leader and team member
3.6.3 Use leadership skills in communications technology project

3.7 Organizational skills
3.7.1 Use time management techniques for work schedules and deadlines

3.8 Integrity, Honesty, Work Habits
3.8.1 Match employers' expectations with appropriate work habits
3.8.2 Identify discrimination and harassment characteristics in the work place

3.5 Problem solving, critical thinking, and decision making related to communications technology
3.5.1 Develop and apply process for problem solving in communications technology
3.5.2 Develop and apply critical thinking strategies to analyze and evaluate communications technology solutions

Unit 4 Exploring technical skills for communications technology

4.1 Identify specific technical skills for related occupations in communications technology
4.1 Identify communications technology processes & related tools and/or equipment
4.2 Develop safe practice with related tools and/or equipment found in communications technology

Unit 5 Practical applications in Communications Technology

5.1 Systems model
5.1.1 Apply universal systems model to communications technology processes
5.1.2 Identify inputs, processes, outputs, and feedback associated with communications technology
5.1.3 Describe how technological systems interact to achieve common goals

5.2 Identify problem to solve in communications technology
5.2.1 Use design processes and techniques to solve problem
5.2.2 Use appropriate tools, equipment, machines, and/or processes
5.2.3 Design quality, reliability, and safety into communications technology solution

5.3 Establish safety regulations and procedures useful in communications technology
5.3.1 Identify needs for safety in communications technology
5.3.2 Develop knowledge of and skill in safe use of materials, machines, and tools
5.3.3 Identify and use procedures for safe use of and handling of hazardous materials
5.3.4 Identify and handle emergency situations in communications technology

5.4 Establish communications technology management system
5.4.1 Develop plan to complete communications technology project
5.4.1.1 Personnel
5.4.1.2 Facilities
5.4.1.3 Finance
5.4.2 Participate in the organization of real or simulated communications technology project

5.8 Evaluate communications technology processes
5.8.1 Record Keeping
5.8.1.1 Product output
5.8.1.2 Quality Control
5.8.1.3 Safety
5.8.1.3 Run Time/Down Time

End of Exploring Communications Technology course outline

Exploring Engineering
Course Description & Outline

Exploring Engineering - is a course that allows students opportunity to explore careers in the engineering field by investigating occupations in this cluster, experiencing typical occupational hands-on activities, gaining basic knowledge and developing basic technical skills which will prepare them for future career courses in one or more occupations. (Adapted from ITEA – CATTS, Introduction to Engineering, Copyright © 2003, used by permission)

Standards Addressed (See Appendix for full description of Standards)

The *Standards for Technological Literacy*© which can be addressed in this course are:

Standard 1	Standard 2	Standard 3	Standard 4	Standard 5
Standard 6	Standard 8	Standard 9	Standard 10	Standard 11
Standard 14	Standard 15	Standard 16	Standard 20	

The *Missouri Show-Me Performance Standards* which can be address in this course are:

Goal 1.1	Goal 1.2	Goal 1.4	Goal 1.5	Goal 1.7
Goal 1.8	Goal 1.10	Goal 2.1	Goal 2.2	Goal 2.3
Goal 2.5	Goal 2.6	Goal 2.7	Goal 3.1	Goal 3.2
Goal 3.3	Goal 3.4	Goal 3.5	Goal 3.6	Goal 3.7
Goal 3.8	Goal 4.1	Goal 4.3	Goal 4.4	Goal 4.5
Goal 4.6	Goal 4.7	Goal 4.8		

The *Missouri Show-Me Knowledge Standards* which can be address in this course are:

In Communication Arts:	CA 1	CA 3	CA 4	CA 5	CA 6
In Fine Arts:	FA 2	FA 4			
In Health/Physical Education:	H 6	H 7			
In Mathematics:	M 1	M 2	M3	M 4	M 6
In Science:	S 2	S 6	S 7	S 8	

Unit 1 Systems and Optimization

Section 1.1 Core concepts in technology

- 1.1.1 Systems
  - 1.1.1.1 Application of logic and creativity with compromises
  - 1.1.1.2 Systems can be embedded within other systems
  - 1.1.1.3 Stability of a system is related to its components
  - 1.1.1.4 Feedback loop may be the most important step
  - 1.1.1.5 Human Systems
    - 1.1.1.5.1 Family
    - 1.1.1.5.2 Government
  - 1.1.1.6 Interaction between human and technological systems
- 1.1.2 Resources
  - 1.1.2.1 Availability
  - 1.1.2.2 Cost
  - 1.1.2.3 Desirability

1.1.2.4 Waste
1.1.2.5 Requirements
1.1.2.5.1 Criteria
1.1.2.5.2 Constraints
1.1.2.5.3 Effect on final design
1.1.3 Optimization and trade-offs
1.1.4 Processes/new technologies
1.1.4.1 New technologies create new processes
1.1.4.2 Can new processes create new technologies?
1.1.5 Controls
1.1.5.1 Quality Control
1.1.5.2 Management
1.1.6 Complex Systems
1.1.6.1 Many layers of controls/feedback loops
1.1.6.2 Provide information

Section 1.2 Medical Technologies
1.2.1 Prevention
1.2.2 Rehabilitation
1.2.3 Vaccines
1.2.4 Pharmaceuticals
1.2.5 Medical and surgical procedures
1.2.6 Genetic engineering
1.2.7 Telemedicine
1.2.7.1 Medicine
1.2.7.2 Telecommunications
1.2.7.3 Virtual presence
1.2.7.4 Computer Engineering
1.2.7.5 Informatics
1.2.7.6 Artificial intelligence
1.2.7.7 Robotics
1.2.7.8 Materials science
1.2.7.9 Perceptual psychology
1.2.8 Biochemistry
1.2.9 Molecular biology
1.2.9.1 Manipulate the genetic materials

Unit 2 Technology/Society Interaction and Ethics

Section 2.1 Technology/society interaction & Ethics
2.1.1 Tech/Society interaction
2.1.1.1 Technology is both a cause and a result of scientific activity
2.1.1.2 Tools created by technology are use by scientists
2.1.1.3 Scientists have needs that, in turn, create tools
2.1.2 Society influences and responds to engineering
2.1.3 Society controls technological development
2.1.3.1 Could big corporations be assisting disease stricken third world countries for "face value"?
2.1.3.2 European markets are more open to the introduction of new products
2.1.3.2.1 Americans are much more likely to fear any type of risk in a new product and more likely to bring about a lawsuit if something unplanned occurs
2.1.4 Historical events have shaped, and will continue to shape, technologies
2.1.4.1 Man on the moon
2.1.4.2 Exxon-Valdez oil spill
2.1.5 Scientific and technological issues are influenced by values
2.1.6 Technology has positive and negative effects
2.1.6.1 Internet banking
2.1.6.2 Nuclear power

2.1.6.3 Coal
2.1.6.4 Gasoline
2.1.5.5 Electric cars (need electricity-An electric car doesn't pollute the environment, but the process of making the electricity does)

2.1.7 Some developments have no projected negative or positive effects
2.1.7.1 Lasers
2.1.7.2 GPS Implants

2.1.8 Politics plays a role in design
2.1.8.1 Lobbyists spend time and monies for specific companies and products
2.1.8.2 Products may get approval because of pressures
2.1.8.3 Smaller ideas with no political influence may not come to light
2.1.8.3.1 These small business solutions may actually be far superior

Section 2.2 Ethics

2.2.1 Professional and legal responsibilities
2.2.1.1 Engineers take an oath similar to the Hippocratic Oath for doctors
2.2.1.2 Guidelines for professional conduct
2.2.1.3 Contractual obligations
2.2.1.4 Legally bound to live up to the performance standards specified

2.2.2 Social responsibilities
2.2.2.1 Design and implement with a social conscience
2.2.2.2 Inform their publics about the risks

2.2.3 Ethical dilemmas
2.2.3.1 Might place their own personal or professional values in conflict with those of employers or clients.
2.2.3.2 Engineering decisions may involve making trade-offs
2.2.3.3 When do engineers stop increasing safety or quality, and accept an increased risk to human life or the environment?

2.2.4 Whistle-blowing
2.2.4.1 Conflict between a company practice and whistle-blower's social conscience
2.2.4.2 Notify someone outside the company
2.2.4.2.1 Newspaper
2.2.4.2.2 Television
2.2.4.2.3 Regulatory agency
2.2.4.3 Attempt to bring public pressure
2.2.4.4 Clear detrimental effects on both the company and the individual
2.2.4.5 Roger Boisjoly
2.2.4.5.1 Morton-Thiokol
2.2.4.5.2 O-ring seals on the Challenger rocket booster
2.2.4.6 Bay Area Rapid Transit (BART) system
2.2.4.6.1 Engineers were fired
2.2.4.6.2 The press publicized the issue
2.2.4.6.3 BART train malfunctioned because of the problem pointed out
2.2.4.6.4 Engineers received award for outstanding service in the public interest

2.2.5 Resolving ethical dilemmas
2.2.5.1 Raise their concern with the management
2.2.5.2 Create channels for internal discussion of the issues
2.2.5.3 Respect the engineer's anonymity
2.2.5.3.1 McDonnell Aircraft solutions
2.2.5.3.2 Raytheon corporation solutions

2.2.6 Code of ethics
2.2.6.1 The Fundamental Principal
2.2.6.1.1 Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

2.2.6.1.1.1 Using their knowledge and skill for the enhancement of human welfare
2.2.6.1.1.2 Being honest and impartial, and serving with fidelity the public, their employees, and clients
2.2.6.1.1.3 Striving to increase the competence and prestige of the engineering profession
2.2.6.1.1.4 Supporting the professional and technical societies of their disciplines

2.2.6.2 The Fundamental Cannons
2.2.6.2.1 Engineers shall hold paramount the safety, health, and welfare of the public in the performance of their professional duties
2.2.6.2.2 Engineers shall perform services only in the areas of their competence
2.2.6.2.3 Engineers shall issue public statements only in an objective and truthful manner
2.2.6.2.4 Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest
2.2.6.2.5 Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others
2.2.6.2.6 Engineers shall associate only with reputable persons or organizations
2.2.6.2.7 Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional development of those engineers under their supervision

Unit 3 Concurrent Engineering and Teamwork

Section 3.1 Concurrent engineering and teamwork
3.1.1 Definition
3.1.1.1 Synchronization or synergism of team members, groups of people or company departments to ensure that every person involved knows and understands the task at hand, the parameters that have to be met and the set of skills that will be employed to solve the problem
3.1.1.2 Integrated Product Development (IPD) is a philosophy that systematically employs a teaming of functional disciplines to integrate and concurrently apply all necessary processes to produce an effective and efficient product that satisfies the customer's needs
3.1.2 Initiated before brainstorming
3.1.2.1 Should be, but not limited to this timeframe
3.1.3 Multidisciplinary teams
3.1.4 Communications
3.2.3.1 Development
3.2.3.2 Manufacturing
3.2.3.3 Marketing
3.2.3.4 Distribution
3.1.5 Techniques, procedures, goals
3.1.6 Compromise
3.1.7 Agreement
3.1.8 Implementation

Section 3.2 Influences on design come from personal characteristics
3.2.1 Multiple persons on a design team helps generate solutions
3.2.1.1 Factors
3.2.1.1.1 Creativity

3.2.1.1.2 Resourcefulness
3.2.1.1.3 Ability to visualize and think abstractly

Section 3.3 Conflicts often occur between group members
3.3.1 Opinions
3.3.2 Backgrounds
3.3.3 Experiences
3.3.4 Personalities

Unit 4: Modeling and Problem Solving

Section 4.1 Modeling
4.1.1 Descriptive Modeling
4.1.1.1 Diagrams
4.1.1.1.1 Cycle
4.1.1.1.1.1 A diagram that is used to show a process with a continuous cycle
4.1.1.1.2 Target
4.1.1.1.2.1 A diagram that is used to show steps toward a goal
4.1.1.1.3 Radial
4.1.1.1.3.1 A diagram that is used to show relationships of elements to a core element
4.1.1.1.4 Venn
4.1.1.1.4.1 A diagram that is used to show areas of overlap between and among element
4.1.1.1.5 Pyramid
4.1.1.1.5.1 A diagram that is used to show foundation-based relationships
4.1.1.2 Used to
4.1.1.2.1 Illustrate various conceptual materials
4.1.1.2.2 Enliven documents
4.1.1.3 Graphs
4.1.1.3.1 Visually appealing; easy for users to see
4.1.1.3.1.1 Comparisons
4.1.1.3.1.2 Patterns
4.1.1.3.1.3 Trends in data
4.1.1.4 Flow Charts
4.1.1.4.1 Document procedures
4.1.1.4.2 Analyze processes
4.1.1.4.3 Indicate work or information flow
4.1.1.4.4 Track cost and efficiency
4.1.1.5 Block Diagrams
4.1.1.5.1 Provides shapes to
4.1.1.5.1.1 Brainstorm
4.1.1.5.1.2 Plan
4.1.1.5.1.3 Communicate
4.1.1.6 Verbal modeling
4.1.1.6.1 Description with words
4.1.1.7 Mathematical modeling
4.1.1.8 Geoinformatics
4.1.1.8.1 e.g. surveying, error theory, Global Position System (GPS), photogrammetry, image analysis, Geographical Information Systems (GIS)
4.1.1.9 Image Processing & Computer Graphics
4.1.1.9.1 e.g. biomedical imaging, industrial vision, material science, remote sensing, scientific visualization and virtual reality
4.1.1.10 Intelligent Signal Processing
4.1.1.10.1 e.g. theory and methods for machine learning/adaptive

signal processing neuroimaging biomedical signal processing, monitor systems, multimedia, humanitarian demeaning

4.1.1.11 Mathematical Physics

4.1.1.11.1 e.g. boundary value problems, vehicle dynamics, Josephson junctions, nonlinear optics, molecular and biomolecular dynamics

4.1.1.12 Numerical Analysis

4.1.1.12.1 e.g. optimization, simulation and inversion, numerical linear algebra, parallel algorithms, partial differential equations, scientific computing

4.11.13 Operations Research

4.1.1.13.1 e.g. logistics, transport optimization, vehicle routing, production and inventory planning , timetabling and crew scheduling

4.1.1.14 Statistics

4.1.1.14.1 e.g. environmental statistics, statistical design and analysis of experiments, time series analysis, stochastic control theory, multivariate analysis and classification, stochastic processes

4.1.1.15 Scale models

4.1.1.15.1 A small object that represents in detail another, often larger object

4.1.1.15.2 A preliminary work or construction that serves as a plan from which a final product is to be made: a clay model ready for casing

4.1.1.15.3 Such a work or construction used in testing or perfecting a final product: a test model of solar- powered vehicle

4.1.2 Functional modeling

4.1.2.1 Computer simulations

4.1.2.1.1 3D solid modeling

4.1.2.1.2 3D animation

4.1.2.1.3 Finite Element Analysis

4.1.2.2 Physical models of real systems with moving parts

Section 4.2 Problem solving

4.2.1 Recognition of need

4.2.1.1 Direct response to specific needs and wants of society

4.2.2 Definition of the problem

4.2.2.1 Specifications clearly stated

4.2.2.2 Constraints clearly stated

4.2.3 Analysis of the problem

4.2.3.1 Brainstorming to formulate possible solutions

4.2.3.2 Thumbnail sketches to track ideas

4.2.4 Selection of a solution

4.2.4.1 Refine preliminary ideas

4.2.4.1.1 Identify workable solutions

4.2.4.1.2 Develop details/annotated sketches

4.2.4.1.3 Graphical analysis of possible solutions

4.2.4.1.4 Design analysis

4.2.4.1.4.1 Compare possible solutions

4.2.4.1.4.2 Refine alternative solutions

4.2.4.1.4.3 Narrow design solutions

4.2.4.2 Chose optimal solution with the aid of a modeling system

4.2.5 Development and Implementation

4.2.5.1 Detailed documentation of final solution (working drawings)

4.2.5.2 Components required for the construction

4.2.5.3 Complete the construction of a prototype
4.2.6 Evaluations and testing
4.2.6.1 Analysis of the prototype
4.2.6.2 Are the specifications met?
4.2.7 Re-design
4.2.7.1 Modifications to the prototype based on the evaluation and testing phase
4.2.7.1.1 Reassess design specifications
4.2.7.1.2 Implement modifications
4.2.7.1.3 Update drawings and prototypes
4.2.7.1.4 Prototype new design solution

Unit 5 Design

Section 5.1 Design
5.1.1 Generate products, processes, and systems based on the recognition of a need
5.1.1.1 Functionality
5.1.1.1.1 Product or solution has to fulfill its intended purpose
5.1.1.1.1.1 Screwdrivers aren't designed to be used as hammers
5.1.1.1.1.2 Tables aren't designed for people to stand on
5.1.1.2 Quality
5.1.1.2.1 Product or solution must be designed to meet certain minimum standards
5.1.1.2.2 In relationship to the conditions of the item's intended use
5.1.1.2.2.1 Quality is defined according to the proper or improper use of the item
5.1.1.2.2.2 Quality has to be evaluated in the context
5.1.1.2.2.2.1 Wearing dress shoes to play basketball
5.1.1.2.2.2.2 Wearing tennis shoes for everyday use
5.1.1.3 Safety
5.1.1.3.1 Comply with codes and regulations
5.1.1.3.2 Provide safe use and operation by the user
5.1.1.3.2.1 Air bags
5.1.1.3.2.1.1 Early design intended to save lives
5.1.1.3.2.1.2 Force of impact injured and sometimes killed users
5.1.1.3.2.2 Child car seats
5.1.1.3.2.2.1 Often installed incorrectly by user
5.1.1.3.2.2.2 Design sometimes failed, injuring child
5.1.1.4 Ergonomics (human factors engineering)
5.1.1.4.1 Percentiles
5.1.1.4.1.1 50 percentile = average of all people in a culture
5.1.1.4.1.2 90 percentile would be toward largest of people
5.1.1.4.1.3 10 percentile would be towards smallest of people
5.1.1.4.2 Culture dictates physical characteristics
5.1.1.4.2.1 American
5.1.1.4.2.2 Chinese
5.1.1.4.2.3 African tribal
5.1.1.4.3 User can operate with ease and maximum efficiency
5.1.1.4.3.1 Chair design
5.1.1.4.3.1.1 For long term use
5.1.1.4.3.1.1.1 Recliners in home
5.1.1.4.3.1.1.2 Desk chairs at work
5.1.1.4.3.1.2 For short term use

5.1.1.4.3.1.2.1 Fast food restaurants
5.1.1.4.3.1.2.2 Classrooms
5.1.1.4.3.2 Brake and gas pedals in vehicles
5.1.1.4.3.2.1 American Females need pedals closer in most vehicles
5.1.1.4.3.2.1.1 Move seat up, then too close to air bag

5.1.1.5 Appearance/Aesthetics
5.1.1.5.1 The appeal of a product is based on:
5.1.1.5.1.1 Materials
5.1.1.5.1.2 Processes
5.1.1.5.1.3 Finish
5.1.1.5.1.4 Color
5.1.1.5.1.5 Shape
5.1.1.5.2 If a consumer doesn't like what they see, they are less likely to buy it
5.1.1.5.2.1 First Toyota cars
5.1.1.5.2.2 Pre-worn clothing (i.e. ripped hats, jeans with holes in them, etc.)

5.1.1.6 Environmental considerations
5.1.1.6.1 Product must be designed so that it does not adversely affect the environment
5.1.1.6.1.1 Wind tunnels
5.1.1.6.1.2 Decrease of vegetation in an area, decreasing oxygen generation and consumption of CO_2

5.1.1.7 Economics
5.1.1.7.1 Produced at least cost without sacrificing safety
5.1.1.7.1.1 Cost down
5.1.1.7.1.2 Profits up
5.1.1.7.2 Sometimes cuts are made to keep profits up
5.1.1.7.2.1 Cuts sometimes lead to unsafe products
5.1.1.7.2.1.1 Cuts in production
5.1.1.7.2.1.2 Cuts in materials
5.1.1.7.2.1.3 Cuts in safety systems
5.1.1.7.2.2 Public is not concerned until something drastic happens
5.1.1.7.3 (e.g.) Sam Poong department store in Japan
5.1.1.7.3.1 Collapsed, killing 1,500 people
5.1.1.7.3.2 Management left after cracks appeared in walls
5.1.1.7.3.2.1 Didn't tell employees, customers
5.1.1.7.3.3 People still shopping, employees still working
5.1.1.7.3.4 Building collapsed because of poor building codes
5.1.1.7.3.4.1 Too much water in the concrete mix to lessen the costs
5.1.1.7.3.4.2 Created a very weak concrete structure

5.1.1.8 Analyze
5.1.1.8.1 Electricity in nature (eels and catfish)
5.1.1.8.2 Cold light (fireflies)
5.1.1.8.3 Jet propulsion (squids)
5.1.1.8.4 Flight (insects, birds)
5.1.1.8.5 Mechanisms (human joints)
5.1.1.8.6 Structures (spider webs, beaver dams)
5.1.1.8.7 Special senses (bats sonar, migration timing)

End of Exploring Engineering course outline

Exploring Information Technology
Course Description & Outline

Exploring Information Technology - is a course that allows students opportunity to explore careers in the information technology field by investigating occupations in this cluster, experiencing typical occupational hands-on activities, gaining basic knowledge and developing basic technical skills which will prepare them for future career courses in one or more occupations.

Standards Addressed (See Appendix for full description of Standards)

The *Standards for Technological Literacy*© which can be addressed in this course are:

Standard 7 Standard 8 Standard 9 Standard 11 Standard 12 Standard 17

The *Missouri Show-Me Performance Standards* which can be address in this course are:

Goal 1.1 Goal 1.2 Goal 1.4 Goal 1.5 Goal 1.8
Goal 1.10 Goal 2.1 Goal 2.5 Goal 2.6 Goal 2.7
Goal 3.1 Goal 4.4 Goal 4.5 Goal 4.6 Goal 4.7
Goal 4.8

The *Missouri Show-Me Knowledge Standards* which can be address in this course are:

In Communication Arts: CA 1 CA 3 CA 4 CA 5 CA 6

In Health/Physical Education: H 6 H 7

In Mathematics: M 1 M 2

In Science: S 8

Unit 1 Introduction to Information Technology Careers

- 1.3 What is Communications Technology?
  - 1.1.1 Defined
  - 1.1.2 Types of information technology
- 1.2 What occupations can be found in information technology?
  - 1.2.1 Network Systems
    - 1.2.1.1 Communications Analyst
    - 1.2.1.2 Data Communications Analyst
    - 1.2.1.3 Information Systems Administrator
    - 1.2.1.4 Information Systems Operator
    - 1.2.1.5 Information Technology Engineer
    - 1.2.1.6 Network: Administrator
    - 1.2.1.7 Engineer
    - 1.2.1.8 Technician
    - 1.2.1.9 PC Support Specialist
    - 1.2.1.10 Systems
      - 1.2.1.10.1 Administrator
      - 1.2.1.10.2 Engineer
      - 1.2.1.10.3 Technical Support Specialist
      - 1.2.1.10.4 User Support Specialist
      - 1.2.1.10.5 Telecommunications Network Technician
    - 1.2.1.11 Other
  - 1.2.2 Information Support and Services

1.2.2.1 Database Development and Administration
1.2.2.1 Data
1.2.2.1.1 Administrator
1.2.2.1.1 Analyst
1.2.2.1.2 Architect
1.2.2.1.3 Modeler
1.2.2.1.4 Other
1.2.2.2 Database
1.2.2.2.1 Administrator
1.2.2.2.2 Analyst
1.2.2.2.3 Developer
1.2.2.2.4 Modeler
1.2.2.2.5 Security Expert
1.2.2.2.6 Systems
1.2.2.2.7.1 Administrator
1.2.2.2.7.2 Analyst Tester
1.2.2.2.7 Other
1.2.3 Technical Writer
1.2.3.1 Desktop Publisher
1.2.3.2 Editor
1.2.3.3 Electronic Publications Specialist
1.2.3.4 Publisher
1.2.3.5 Instructional Designer, Online Publisher
1.2.3.6 Technical Communicator
1.2.3.7 Writer
1.2.3.8 Other
1.2.4 Technical Support
1.2.4.1 Analyst
1.2.4.2 Call Center Support Representative
1.2.4.3 Content Manager
1.2.4.4 Customer
1.2.4.4.1 Liaison
1.2.4.4.2 Service Representative
1.2.4.5 Help Desk
1.2.4.5.1 Specialist
1.2.4.5.2 Technician
1.2.4.6 Maintenance Technician
1.2.4.7 Product Support Engineer
1.2.4.8 Sales Support Technician
1.2.4.9 Technical
1.2.4.9.1 Support Engineer
1.2.4.9.2 Support Representative
1.2.4.9.3 Testing Engineer
1.2.4.10 Enterprise Systems Analysis and Integration
1.2.4.10.1 Application Integrator
1.2.4.10.2 Other
1.2.4.11 Data
1.2.4.11.1 Systems Designer
1.2.4.11.2 Warehouse Designer
1.2.4.11.3 E-Business Specialist
1.2.4.11.4 Other
1.2.4.12 Information Systems
1.2.4.12.1 Architect
1.2.4.12.2 Planner
1.2.4.13 Systems
1.2.4.13.1 Analyst

1.2.4.13.2 Architect
1.2.4.13.3 Integrator

1.2.5 Interactive Media
1.2.5.1 Digital Media
1.2.5.1.1 2D/3D Artist
1.2.5.1.2 Animator
1.2.5.1.3 Audio/Video Engineer
1.2.5.1.4 Designer
1.2.5.1.5 Media/Instructional Designer
1.2.5.1.6 Other
1.2.5.2 Multimedia
1.2.5.2.1 Authoring Specialist
1.2.5.2.2 Developer
1.2.5.2.3 Specialist
1.2.5.2.4 Producer
1.2.5.2.5 Programmer
1.2.5.2.6 Streaming Media Specialist
1.2.5.2.7 Virtual Reality Specialist
1.2.5.2.8 Other
1.2.5.3 Web
1.2.5.3.1 Designer
1.2.5.3.2 Producer

1.2.6 Web Development and Administration
1.2.6.1 Web
1.2.6.1.1 Administrator
1.2.6.1.2 Architect
1.2.6.1.3 Designer
1.2.6.1.4 Page Developer
1.2.6.1.5 Producer
1.2.6.1.6 Site Developer
1.2.6.1.7 Other
1.2.6.2 Webmaster

1.2.7 Programming and Software Development
1.2.7.1 Programming / Software Engineering
1.2.7.1.1 Applications
1.2.7.1.1.1 Analyst
1.2.7.1.1.2 Engineer
1.2.7.1.1.3 Computer Engineer
1.2.7.1.1.4 Other
1.2.7.2 Operating System
1.2.7.2.1 Designer/Engineer
1.2.7.2.2 Programmer Analyst
1.2.7.2.3 Programmer
1.2.7.2.4 Other
1.2.7.3 Software Applications
1.2.7.3.1 Architect
1.2.7.3.2 Design Engineer
1.2.7.3.2 Development Engineer
1.2.7.3.3 Tester
1.2.7.3.4 Other
1.2.7.4 Systems
1.2.7.4.1 Analyst
1.2.7.4.2 Administrator
1.2.7.4.3 Test Engineer
1.2.7.4.4 Tester

1.3 How is information technology organized?

1.3.1 Network Systems
1.3.2 Information Support and Services
1.3.3 Technical Writer
1.3.4 Technical Support
1.3.5 Interactive Media
1.3.6 Web Development and Administration
1.3.7 Programming and Software Development

1.4 Investigating specific occupations
1.4.1 What are the working conditions of this occupation?
1.4.2 What education do you need for this occupation?
1.4.3 What is the salary range for this occupation?
1.4.4 What is the long-range outlook for this occupation?
1.4.5 What technical skills must you have for this occupation?
1.4.6 What academic skills must you have for this occupation?

1.5 Interviewing the professional
1.5.1 Identifying professionals in the occupation
1.5.2 Corresponding with the professional
1.5.3 Interview with professional
1.5.3.1 Telephone interview
1.5.3.2 E-mail interview
1.5.3.3 Face-to-Face interview

Unit 2 Exploring academic skills for information technology

2.9 Applied communications in information technology
2.9.1 Using written, verbal, and visual communication techniques consistent with industry standards

2.10 Applied mathematics in information technology
2.10.1 Using mathematics concepts in information technology

2.11 Applied science in information technology
2.11.1 Using scientific principles in information technology

2.12 Applied measurement techniques in information technology
2.12.1 Using appropriate measuring techniques found in information technology

Unit 3 Exploring personal skills for information technology

3.9 Teamwork
3.9.1 How to work as a team member
3.9.2 Using teamwork to solve problems

3.10 Leadership
3.10.1 Identify characteristics of good leader
3.10.2 Identify different roles between team leader and team member
3.10.3 Use leadership skills in information technology project

3.11 Organizational skills
3.11.1 Use time management techniques for work schedules and deadlines

3.12 Integrity, Honesty, Work Habits
3.12.1 Match employers' expectations with appropriate work habits
3.12.2 Identify discrimination and harassment characteristics in the work place

3.5 Problem solving, critical thinking, and decision making related to information technology
3.5.1 Develop and apply process for problem solving in information technology
3.5.2 Develop and apply critical thinking strategies to analyze and evaluate information technology solutions

Unit 4 Exploring technical skills for information technology

4.1 Identify specific technical skills for related occupations in information technology
4.1 Identify information technology processes & related tools and/or equipment
4.2 Develop safe practice with related tools and/or equipment found in information technology

Unit 5 Practical applications in Information Technology

5.1 Systems model
5.1.1 Apply universal systems model to information technology processes

- 5.1.2 Identify inputs, processes, outputs, and feedback associated with information technology
- 5.1.3 Describe how technological systems interact to achieve common goals

5.2 Identify problem to solve in information technology
- 5.2.1 Use design processes and techniques to solve problem
- 5.2.2 Use appropriate tools, equipment, machines, and/or processes
- 5.2.3 Design quality, reliability, and safety into information technology solution

5.3 Establish safety regulations and procedures useful in information technology
- 5.3.1 Identify needs for safety in information technology
- 5.3.2 Develop knowledge of and skill in safe use of materials, machines, and tools in information technology
- 5.3.3 Identify procedures for safe use of and handling of hazardous materials in information technology
- 5.3.4 Identify and handle emergency situations in information technology

5.4 Establish information technology management system
- 5.4.1 Develop plan to complete information technology project
  - 5.4.1.1 Personnel
  - 5.4.1.2 Facilities
  - 5.4.1.3 Finance
- 5.4.2 Participate in the organization of real or simulated information technology project

5.8 Evaluate information technology processes
- 5.8.1 Record Keeping
  - 5.8.1.1 Product output
  - 5.8.1.2 Quality Control
  - 5.8.1.3 Safety
  - 5.8.1.3 Run Time/Down Time

End of Exploring Information Technology course outline

Exploring Manufacturing
Course Description & Outline

Exploring Manufacturing - is a course that allows students opportunity to explore careers in the manufacturing field by investigating occupations in this cluster, experiencing typical occupational hands-on activities, gaining basic knowledge and developing basic technical skills which will prepare them for future career courses in one or more occupations.

Standards Addressed (See Appendix for full description of Standards)

The *Standards for Technological Literacy*© which can be addressed in this course are:

Standard 7 Standard 8 Standard 9 Standard 11 Standard 12 Standard 19

The *Missouri Show-Me Performance Standards* which can be address in this course are:

Goal 1.1 Goal 1.2 Goal 1.4 Goal 1.5 Goal 1.8
Goal 1.10 Goal 2.1 Goal 2.5 Goal 2.6 Goal 2.7
Goal 3.1 Goal 4.4 Goal 4.5 Goal 4.6 Goal 4.7
Goal 4.8

The *Missouri Show-Me Knowledge Standards* which can be address in this course are:

In Communication Arts: CA 1 CA 3 CA 4 CA 5 CA 6

In Health/Physical Education: H 6 H 7

In Mathematics: M 1 M 2

In Science: S 8

Unit 1 Introduction to Manufacturing Careers

- 1.4 What is manufacturing?
  - 1.1.1 Defined
  - 1.1.2 Types of manufacturing
- 1.2 What occupations can be found in manufacturing?
  - 1.2.1 Production
    - 1.2.1.1 Assemblers
    - 1.2.1.2 Automated Manufacturing Technicians
    - 1.2.1.3 Calibration Technicians
    - 1.2.1.4 Electrical Installers and Repairers
    - 1.2.1.5 Extruding and Drawing Machine Setters/Set-Up Operators
    - 1.2.1.6 Machine Operators
    - 1.2.1.7 Foundry Workers
    - 1.2.1.8 Hand Packers and Packagers
    - 1.2.1.9 Instrument Makers
    - 1.2.1.10 Managers, Supervisors
    - 1.2.1.11 Millwrights
    - 1.2.1.12 Painters
    - 1.2.1.13 Pattern & Model Makers
    - 1.2.1.14 Precision Optical Goods Workers
    - 1.2.1.15 Sheet Metal Workers
    - 1.2.1.16 Solderers, Brazers and Welders
    - 1.2.1.17 Tool and Die Makers

1.2.1.18 Other

1.2.2 Production Process Development
- 1.2.2.1 Design Engineers
- 1.2.2.2 Electrical and Electronic Technicians and Technologists
- 1.2.2.3 Electronics Engineers and Technologists
- 1.2.2.4 Industrial Engineers
- 1.2.2.5 Labor Relations Managers
- 1.2.2.6 Manufacturing Engineers and Technicians
- 1.2.2.7 Power Generating and Reactor Plant Operators
- 1.2.2.8 Precision Inspectors, Testers, and Graders
- 1.2.2.9 Production Managers
- 1.2.2.10 Purchasing Agents
- 1.2.2.11 Supervisors
- 1.2.2.12 Other

1.2.3 Maintenance, Installers, Repairers
- 1.2.3.1 Biomedical Equipment Technicians
- 1.2.3.2 Boilermakers
- 1.2.3.3 Computer Installers/Repairers
- 1.2.3.4 Computer Maintenance Technicians
- 1.2.3.5 Electrical Equipment Installers/Repairers
- 1.2.3.6 Facility Electricians
- 1.2.3.7 Industrial Facilities Managers
- 1.2.3.8 Industrial Machinery Mechanics
- 1.2.3.9 Industrial Maintenance
  - 1.2.3.9.1 Electricians
  - 1.2.3.9.2 Mechanics
  - 1.2.3.9.3 Technicians
- 1.2.3.10 Instrument Calibration and Repairers
- 1.2.3.11 Instrument Control Technicians
- 1.2.3.12 Job/Fixture Designers
- 1.2.3.13 Laser Systems Technicians
- 1.2.3.14 Meter Installers/Repairers
- 1.2.3.15 Millwrights
- 1.2.3.16 Plumbers, Pipe Fitters and Steam Fitters
- 1.2.3.17 Other

1.2.4 Quality Assurance
- 1.2.4.1 Calibration Technicians
- 1.2.4.2 Inspectors
- 1.2.4.3 Lab Technicians
- 1.2.4.4 Process Control Technicians
- 1.2.4.5 Quality Control Technicians
- 1.2.4.6 Quality Engineers
- 1.2.4.7 SPC Coordinators
- 1.2.4.8 Other

1.2.5 Logistics & Inventory Control (note: also part of Transportation & Distribution Career Cluster)
- 1.2.5.1 Communications, Transportation and Utilities Managers
- 1.2.5.2 Dispatchers
- 1.2.5.3 Freight, Stock, and Material Movers
- 1.2.5.4 Industrial Truck and Tractor Operators
- 1.2.5.5 Logistical Engineers
- 1.2.5.6 Material Handlers
- 1.2.5.7 Material Movers
- 1.2.5.8 Process Improvement Technicians
- 1.2.5.9 Quality Control Technicians
- 1.2.5.10 Traffic Managers

1.2.5.11 Traffic, Shipping, and Receiving Clerks
1.2.5.12 Other

1.2.6 Health, Safety & Environmental Assurance
1.2.6.1 Environmental Engineers
1.2.6.2 Environmental Specialists
1.2.6.3 Health and Safety Representatives
1.2.6.4 Safety Coordinators
1.2.6.5 Safety Engineers
1.2.6.6 Safety Team Leaders
1.2.6.7 Safety Technicians
1.2.6.8 Other

1.3 How is manufacturing organized?
1.3.1 Design/Engineering
1.3.2 Marketing
1.3.3 Finance
1.3.4 Procurement
1.3.5 Distribution/Warehousing
1.3.6 Production
1.3.7 Safety
1.3.8 Maintenance
1.3.9 Quality Assurance

1.4 Investigating specific occupations
1.4.1 What are the working conditions of this occupation?
1.4.2 What education do you need for this occupation?
1.4.3 What is the salary range for this occupation?
1.4.4 What is the long-range outlook for this occupation?
1.4.5 What technical skills must you have for this occupation?
1.4.6 What academic skills must you have for this occupation?

1.5 Interviewing the professional
1.5.1 Identifying professionals in the occupation
1.5.2 Corresponding with the professional
1.5.3 Interview with professional
1.5.3.1 Telephone interview
1.5.3.2 E-mail interview
1.5.3.3 Face-to-Face interview

Unit 2 Exploring academic skills for manufacturing

2.13 Applied communications in manufacturing
2.13.1 Using written, verbal, and visual communication techniques consistent with industry standards

2.14 Applied mathematics in manufacturing
2.14.1 Using mathematics concepts in manufacturing technology

2.15 Applied science in manufacturing
2.15.1 Using scientific principles in manufacturing technology

2.16 Applied measurement techniques in manufacturing
2.16.1 Using appropriate measuring techniques found in manufacturing

Unit 3 Exploring personal skills for manufacturing

3.13 Teamwork
3.13.1 How to work as a team member
3.13.2 Using teamwork to solve problems

3.14 Leadership
3.14.1 Identify characteristics of good leader
3.14.2 Identify different roles between team leader and team member
3.14.3 Use leadership skills in manufacturing project

3.15 Organizational skills
3.15.1 Use time management techniques for work schedules and deadlines

3.16 Integrity, Honesty, Work Habits
- 3.16.1 Match employers' expectations with appropriate work habits
- 3.16.2 Identify discrimination and harassment characteristics in the work place

3.5 Problem solving, critical thinking, and decision making related to manufacturing
- 3.5.1 Develop and apply process for problem solving in manufacturing
- 3.5.2 Develop and apply critical thinking strategies to analyze and evaluate manufacturing solutions

Unit 4 Exploring technical skills for manufacturing

4.1 Identify the chemical, mechanical, and physical properties of manufacturing materials

4.1 Identify manufacturing processes & related tools and/or equipment

4.2 Develop safe practice with related tools and/or equipment

4.3 Develop an understanding and basic skill for precision and non-precision measurement
- 4.3.1 Identify and use different quality control applications in manufacturing
- 4.3.2 Develop and apply continuous quality improvement to the production of product

Unit 5 Running a manufacturing enterprise

5.1 Systems model
- 5.1.1 Apply universal systems model to manufacturing process
- 5.1.2 Identify inputs, processes, outputs, and feedback associated with manufacturing
- 5.1.3 Describe how technological systems interact to achieve common goals

5.2 Identify and/or design product to manufacture
- 5.2.1 Use design processes and techniques
- 5.2.2 Develop or improve a product that meets specified objectives
- 5.2.3 Design quality, reliability, and safety into product and manufacturing system

5.3 Establish safety regulations and procedures useful in manufacturing
- 5.3.1 Identify needs for safety in manufacturing
- 5.3.2 Develop knowledge of and skill in safe use of materials, machines, and tools
- 5.3.3 Identify and use procedures for safe use of and handling of hazardous materials
- 5.3.4 Identify and handle emergency situations in manufacturing

5.4 Procuring raw and stock materials for production
- 5.4.1 Identify raw materials needed for manufacturing product
- 5.4.2 Identify stock materials needed for manufacturing product
- 5.4.3 Develop procedures for receiving, controlling and distributing raw and stock materials within manufacturing process

5.5 Designing and establishing manufacturing assembly line
- 5.5.1 Identify and select appropriate manufacturing system
  - 5.5.1.1 Continuous
  - 5.5.1.2 Intermittent
  - 5.5.1.3 Custom
  - 5.5.1.4 Other
- 5.5.2 Establish manufacturing processes
  - 5.5.2.1 Process raw materials
  - 5.5.2.2 Alter stock materials
  - 5.5.2.3 Assembly procedures
- 5.5.3 Establish quality control standards and procedures for manufacturing system
  - 5.5.3.1 Standards
    - 5.5.3.1.1 Fit
    - 5.5.3.1.2 Finish
    - 5.5.3.1.3 Operation
  - 5.5.3.2 Procedures
    - 5.5.3.2.1 Measurement inspection
    - 5.5.3.2.2 Visual inspection
    - 5.5.3.2.3 Operational inspection

5.5.3.3 Apply appropriate codes, laws, standards, or regulations to manufacturing procedures
5.5.3.3.1 Occupational Safety and Health Administration (OSHA)
5.5.3.3.2 National Electrical Code (NEC)
5.5.3.3.3 American Society for Testing Materials (ASTM)

5.6 Establish manufacturing management system
5.6.1 Develop plan to complete manufacturing project
5.6.1.1 Personnel
5.6.1.2 Facilities
5.6.1.3 Finance
5.6.2 Participate in the organization of real or simulated manufacturing project

5.7 Run production system
5.7.1 Operation of production system
5.7.2 Maintenance in manufacturing process
5.7.2.1 Handling and storing of tools and materials
5.7.2.2 Manufacturers' procedures on tools/equipment/machines
5.7.2.3 Accounting of preventative maintenance

5.8 Evaluate manufacturing process
5.8.1 Record Keeping
5.8.1.1 Product output
5.8.1.2 Quality Control
5.8.1.3 Safety
5.8.1.3 Run Time/Down Time

End of Exploring Manufacturing course outline

Exploring Transportation & Distribution
Course Description & Outline

Exploring Transportation & Distribution - is a course that allows students opportunity to explore careers in the transportation and distribution fields by investigating occupations in this cluster, experiencing typical occupational hands-on activities, gaining basic knowledge and developing basic technical skills which will prepare them for future career courses in one or more occupations.

Standards Addressed (See Appendix for full description of Standards)

The *Standards for Technological Literacy*© which can be addressed in this course are:

Standard 7 Standard 8 Standard 9 Standard 11 Standard 12 Standard 18

The *Missouri Show-Me Performance Standards* which can be address in this course are:

Goal 1.1 Goal 1.2 Goal 1.4 Goal 1.5 Goal 1.8
Goal 1.10 Goal 2.1 Goal 2.5 Goal 2.6 Goal 2.7
Goal 3.1 Goal 4.4 Goal 4.5 Goal 4.6 Goal 4.7
Goal 4.8

The *Missouri Show-Me Knowledge Standards* which can be address in this course are:

In Communication Arts: CA 1 CA 3 CA 4 CA 5 CA 6

In Health/Physical Education: H 6 H 7

In Mathematics: M 1 M 2

In Science: S 2 S 6 S 7 S 8

In Social Studies: SS 5

Unit 1 Introduction to Transportation & Distribution

- 1.5 What are Transportation & Distribution Systems?
  - 1.5.1 Defined
  - 1.1.2 Types of transportation systems
  - 1.1.3 Types of distribution systems
- 1.2 What occupations can be found in transportation & distribution?
  - 1.2.1 Transportation Operations
    - 1.2.1.1 Air/Space Transportation
      - 1.2.1.1.1 Airplane pilots/copilots
      - 1.2.1.1.2 Flight engineers
      - 1.2.1.1.3 Flight attendants
      - 1.2.1.1.4 Air traffic controllers
      - 1.2.1.1.5 Aircraft cargo handling supervisors
      - 1.2.1.1.6 Other
    - 1.2.1.2 Rail Transportation
      - 1.2.1.2.1 Dispatchers-rail
      - 1.2.1.2.2 Traffic managers
      - 1.2.1.2.3 Locomotive engineers
      - 1.2.1.2.4 Railyard conductors and yardmasters
      - 1.2.1.2.5 Railroad brake, signal and switch operators (including train crew members and yard workers)

1.2.1.2.6 Railyard engineers
1.2.1.2.7 Other
1.2.1.3 Water Transportation
1.2.1.3.1 Dispatchers—water
1.2.1.3.2 Traffic managers
1.2.1.3.3 Captains
1.2.1.3.4 Pilots of water vessels
1.2.1.3.5 Sailors and marine oilers
1.2.1.3.6 Ship engineers
1.2.1.3.7 Bridge and lock tenders
1.2.1.3.8 Other
1.2.1.4 Road Transportation
1.2.1.4.1 Dispatchers
1.2.1.4.1.1 Truck/bus/taxi, traffic managers
1.2.1.4.2 Truck drivers
1.2.1.4.2.1 Tractor-trailer
1.2.1.4.2.2 Light or delivery services
1.2.1.4.3 Bus drivers
1.2.1.4.3.1 Transit and intercity
1.2.1.4.3.2 Bus drivers-school
1.2.1.4.4 Taxi drivers and chauffeurs
1.2.1.4.5 Truck/bus/taxi terminal operations and support jobs
1.2.1.5 Transit Systems
1.2.1.5.1 Mass transit
1.2.1.5.1.1 Dispatchers
1.2.1.5.1.1.1 Bus
1.2.1.5.1.1.2 Rail
1.2.1.5.1.2 Traffic managers
1.2.1.5.1.2.1 Bus
1.2.1.5.1.2.2 Rail
1.2.1.5.1.3 Drivers—transit and intercity
1.2.1.5.1.3.1 Bus
1.2.1.5.1.3.2 Subway and streetcar operators
1.2.1.5.1.4 Other
1.2.2 Logistics Planning and Management Services
1.2.2.1 Logisticians
1.2.2.2 Logistics managers
1.2.2.3 Logistics Engineers
1.2.2.4 Logistics analysts
1.2.2.5 Logistics consultants
1.2.2.6 International logistics
1.2.2.7 Other
1.2.3 Warehousing & Distribution Center Operations
1.2.3.1 Warehouse managers
1.2.3.2 Industrial and packaging engineers
1.2.3.3 Traffic, shipping and receiving clerks
1.2.3.4 Production, planning, expediting clerks
1.2.3.5 First-line supervisors/managers of helpers
1.2.3.6 Material movers-hand
1.2.3.7 First-line supervisors/managers of transportation and material-moving machine and vehicle operators
1.2.3.8 Car, truck and ship loaders
1.2.3.9 Packers and packagers-hand
1.2.3.10 Other
1.2.4 Facility & Mobile Equipment Maintenance
1.2.4.1 Facility

1.2.4.1.1 Facility maintenance managers and engineers
1.2.4.1.2 Industrial equipment mechanics
1.2.4.1.3 Industrial electricians
1.2.4.1.4 Electrical/electronic technicians
1.2.4.1.5 Facility/terminal maintenance
1.2.4.1.6 Other

1.2.4.2 Mobile Equipment
1.2.4.2.1 General
1.2.4.2.1.1 Mobile equipment maintenance managers
1.2.4.2.1.2 Electrical and electronic installers & repairers
1.2.4.2.1.3 Mobile heavy equipment mechanics
1.2.4.2.1.4 Other

1.2.4.3 Air/Space
1.2.4.3.1 Aerospace engineering and operations technicians
1.2.4.3.2 Aircraft mechanics and service technicians
1.2.4.3.3 Airframe mechanics
1.2.4.3.4 Power plant mechanics
1.2.4.3.5 Aircraft engine specialists
1.2.4.3.6 Aircraft body and bonded structure repairers
1.2.4.3.7 Avionics technicians
1.2.4.3.8 Other

1.2.4.4 Water
1.2.4.4.1 Motorboat mechanics
1.2.4.4.2 Ship mechanics and repairers
1.2.4.4.3 Motorboat mechanics
1.2.4.4.4 Automotive/truck mechanics and body repairers
1.2.4.4.5 Other

1.2.4.5 Rail
1.2.4.5.1 Rail car repairers
1.2.4.5.2 Signal and track switch repairers
1.2.4.5.3 Rail locomotive and car mechanics and repairers
1.2.4.5.4 Other

1.2.4.6 Road
1.2.4.6.1 Electronic equipment installers and repairers
1.2.4.6.1.1 Motor vehicle
1.2.4.6.2 Automotive body and related repairers
1.2.4.6.3 Automotive glass installers and repairers
1.2.4.6.4 Automotive service technicians and mechanics
1.2.4.6.5 Automotive master mechanics
1.2.4.6.6 Automotive specialty technicians
1.2.4.6.7 Bus and truck mechanics and diesel engine specialists
1.2.4.6.8 Motorcycle mechanics
1.2.4.6.9 Bicycle repairers
1.2.4.6.10 Tire repairers and changers
1.2.4.6.11 Other

1.2.5 Transportation Systems/Infrastructure Planning, Management, & Regulation
1.2.5.1 General
1.2.5.1.1 Intermodal
1.2.5.1.1.1 Urban and regional planners
1.2.5.1.2 Civil engineers
1.2.5.1.2.1 Engineering technicians
1.2.5.1.2.2 Surveying and mapping technicians
1.2.5.1.3 Government service executives
1.2.5.1.4 Environmental compliance inspectors
1.2.5.1.5 Other

1.2.5.2 Air/Space

- 1.2.5.2.1 Air traffic controllers
- 1.2.5.2.2 Aviation inspectors
- 1.2.5.2.3 Other
- 1.2.5.3 Road
  - 1.2.5.3.1 Traffic engineers
  - 1.2.5.3.2 Traffic technicians
  - 1.2.5.3.3 Motor vehicle inspectors
  - 1.2.5.3.4 Freight inspectors
  - 1.2.5.3.5 Other
- 1.2.5.4 Rail
  - 1.2.5.4.1 Railroad inspectors
  - 1.2.5.4.2 Other
- 1.2.5.5 Water
  - 1.2.5.5.1 Marine cargo inspectors
  - 1.2.5.5.2 Vessel traffic control specialists
  - 1.2.5.5.3 Other
- 1.2.5.6 Transit
  - 1.2.5.6.1 Public transportation inspectors
  - 1.2.5.6.2 Other

- 1.2.6 Health, Safety & Environmental Management
  - 1.2.6.1 Health and safety managers
  - 1.2.6.2 Industrial health and safety engineers
  - 1.2.6.3 Environmental scientists and specialists
  - 1.2.6.4 Environmental science and protection technicians
  - 1.2.6.5 Environmental managers and engineers
  - 1.2.6.6 Environmental compliance inspectors * Safety analysts
  - 1.2.6.7 Other
- 1.2.7 Sales & Service
  - 1.2.7.1 Marketing managers
    - 1.2.7.1.1 Sales managers
    - 1.2.7.1.2 Sales representatives
      - 1.2.7.1.2.1 transportation/logistics services
  - 1.2.7.2 Reservation, travel and transportation agents/clerks
  - 1.2.7.3 Cargo and freight agents
  - 1.2.7.4 Customer service managers
    - 1.2.7.4.1 Customer service representatives
  - 1.2.7.5 Customer order and billing clerks
  - 1.2.7.6 Cashiers, counter and rental clerks

1.3 How are transportation systems organized?
- 1.3.1 Transportation of people
  - 1.3.1.1 Private transportation
  - 1.3.1.2 Public transportation
  - 1.3.1.3 Maintenance/Repair
  - 1.3.1.4 Safety
- 1.3.2 Transportation of goods
  - 1.3.2.1 Public vehicle transportation
  - 1.3.2.2 Private business vehicle transportation
  - 1.3.2.3 Maintenance/Repair
  - 1.3.2.4 Safety
- 1.3.3 Rail, Road, Air/Space, Sea
- 1.3.4 Safety

1.4 How are distribution systems organized?
- 1.4.1 Warehousing
- 1.3.5 Packaging
- 1.3.6 Shipping/Receiving
- 1.3.7 Safety

1.3.8 Maintenance
1.3.9 Management

1.5 Investigating specific occupations
1.5.1 What are the working conditions of this occupation?
1.5.2 What education do you need for this occupation?
1.5.3 What is the salary range for this occupation?
1.5.4 What is the long-range outlook for this occupation?
1.5.5 What technical skills must you have for this occupation?
1.5.6 What academic skills must you have for this occupation?

1.6 Interviewing the professional
1.6.1 Identifying professionals in the occupation
1.6.2 Corresponding with the professional
1.6.3 Interview with professional
1.6.3.1 Telephone interview
1.6.3.2 E-mail interview
1.6.3.3 Face-to-Face interview

Unit 2 Exploring academic skills for transportation & distribution

2.1 Applied communications in transportation & distribution
2.1.1 Using written, verbal, and visual communication techniques consistent with industry standards

2.2 Applied mathematics in transportation & distribution
2.2.1 Using mathematics concepts in transportation & distribution technology

2.3 Applied science in transportation & distribution
2.3.1 Using scientific principles in transportation & distribution

2.4 Applied measurement techniques in transportation & distribution
2.4.1 Using appropriate measuring techniques found in transportation & distribution

Unit 3 Exploring personal skills for transportation & distribution

3.1 Teamwork
3.1.1 How to work as a team member
3.1.2 Using teamwork to solve problems

3.2 Leadership
3.2.1 Identify characteristics of good leader
3.2.2 Identify different roles between team leader and team member
3.2.3 Use leadership skills in transportation and distribution projects

3.3 Organizational skills
3.3.1 Use time management techniques for work schedules and deadlines

3.4 Integrity, Honesty, Work Habits
3.4.1 Match employers' expectations with appropriate work habits
3.4.2 Identify discrimination and harassment characteristics in the work place

3.5 Problem solving, critical thinking, and decision making related to transportation and distribution
3.5.1 Develop and apply process for problem solving in transportation and distribution
3.5.2 Develop and apply critical thinking strategies to analyze and evaluate transportation and distribution solutions

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3.5.1 Develop and apply process for problem solving in transportation & distribution
3.5.2 Develop and apply critical thinking strategies to analyze and evaluate transportation & distribution solutions

Unit 4 Exploring technical skills for transportation & distribution

4.1 Troubleshoot transportation & distribution systems using appropriate tools and/or equipment
4.1 Identify transportation & distribution related tools and/or equipment
4.2 Develop safe practice with related tools and/or equipment
4.3 Develop an understanding and basic skill for precision and non-precision measurement
4.3.1 Identify and use different quality control applications in transportation &

distribution systems
4.3.2 Develop and apply continuous quality improvement in transportation & distribution systems

Unit 5 Functioning in transportation & distribution systems

5.1 Design a distribution system for storing and shipping goods
- 5.1.1 Apply universal systems model to distribution system
- 5.1.2 Identify inputs, processes, outputs, and feedback associated with distribution system
- 5.1.3 Describe how technological systems interact to achieve this common goal

5.2 Design a transportation system for moving general public
- 5.2.1 Apply universal systems model to transportation system
- 5.2.2 Identify inputs, processes, outputs, and feedback associated with transportation system
- 5.2.3 Describe how technological systems interact to achieve this common goal

5.3 Establish safety regulations and procedures useful in transportation systems
- 5.3.1 Identify needs for safety in transportation systems
- 5.3.2 Develop knowledge of and skill in safe use of materials, machines, and tools used in transportation systems
- 5.3.3 Identify and use procedures for safe use of and handling of hazardous materials
- 5.3.4 Identify and handle emergency situations in transportation systems

5.4 Establish safety regulations and procedures useful in distribution systems
- 5.4.1 Identify needs for safety in distribution systems
- 5.4.2 Develop knowledge of and skill in safe use of materials, machines, and tools used in distribution systems
- 5.4.3 Identify and use procedures for safe use of and handling of hazardous materials in distribution systems
- 5.4.3 Identify and handle emergency situations in distribution systems
- 5.4.3 Establish quality control standards and procedures for transportation and distribution systems
  - 5.4.3.1 Standards
  - 5.4.3.2 Procedures
  - 5.4.3.3 Apply appropriate codes, laws, standards, or regulations to transportation and distribution systems
    - 5.4.3.3.1 Occupational Safety and Health Administration (OSHA)
    - 5.4.3.3.2 National Transportation Safety Board (NTSB)
    - 5.4.3.3.3 Society of Automotive Engineers (SAE)
    - 5.4.3.3.4 Federal Aviation Administration (FAA)
    - 5.4.3.3.5 Federal Railroad Administration (FRA)

5.5 Establish distribution management system
- 5.5.1 Develop plan to complete distribution project
  - 5.5.1.1 Personnel
  - 5.5.1.2 Facilities
  - 5.5.1.3 Finance
- 5.5.2 Participate in the organization of real or simulated distribution project

5.6 Establish transportation management system
- 5.6.1 Develop plan to complete transportation project
  - 5.6.1.1 Personnel
  - 5.6.1.2 Facilities
  - 5.6.1.3 Finance
- 5.6.2 Participate in the organization of real or simulated transportation project

5.7 Maintain transportation and distribution systems
- 5.7.1 Operation of transportation and distribution systems
- 5.7.2 Maintenance in transportation and distribution systems
  - 5.7.2.1 Handling and storing of tools and materials
  - 5.7.2.2 Performance of scheduled and unscheduled maintenance in transportation and distribution systems

5.7.2.3 Accounting of preventative maintenance in transportation and distribution systems

5.8 Evaluate transportation and distribution process

5.8.1 Record Keeping

5.8.1.1 Product output

5.8.1.2 Quality Control

5.8.1.3 Safety

5.8.1.3 Run Time/Down Time

End of Exploring Transportation & Distribution course outline

C. Industrial Technology Program

The *Industrial Technology* program is designed to provide general hands-on craft skills and exposure to avocational interests of students. The courses offered follow traditional materials and processes, energy and power, and communications skill based content and are offered at the discretion and needs of the Local Education Authority (LEA) as a practical arts credit option. The *Industrial Technology* program as a practical arts offering is not available for Missouri Career Education (formally Missouri Vocational Education) program approval.

Level I: Awareness Courses	
•Elementary School Technology Education EL TEC K-6 C&D 105400 Grades K-6	This course develops an initial awareness of the technological world. It provides opportunities for exploring, manipulating and planning with tools, materials & processes by using technological activities that reinforce basic mathematics, science & social studies skills.
Level II: Foundation Building Course	
Introduction to Industrial Technology I, II, III IN TEC 6-9 C&D 105405 Grades 6-9	This course develops a foundation of technological understanding and capability that provides an overview upon which future courses can build. Students systematically survey energy & power, materials & processing, & communications technology with demonstrations and practical activities that develop understanding, attitude, skill & problem-solving capability.
Level III: Initial and Intermediate Competency Mastery Courses Technology Specialization I Courses	
These courses introduce, either in combined form or single-system focus, the systems of industrial technology to students. They are the first of the specialization courses.	
Exploration of Industrial Technology EX IND TEC C&D 105450 Grades 8-12	An exploration of industrial technology's three systems (energy & power, materials & processes, communications) that builds depth & breadth. The emphasis in on increased capability with a greater variety of tools, materials, processes, career awareness and reinforcement of basic skills/core competencies.
Introduction to Communication Technology COMMUN C&D 105435 Grades 9-12	Students develop communication technology capabilities through activities with graphic arts, photography, electronic communication, biological system communication, drafting (CAD) & design,

	media and information storage & retrieval. Emphasis is placed on developing understanding of the concepts that underlie each application.
Introduction to Energy & Power Technology ENGY-POWER C&D 105410 Grades 9-12	Students develop energy & power technology capabilities through activities with energy, power, instrumentation, control, electricity/electronics, transportation, conservation, hydraulics & pneumatics & bio-related energy. Emphasis is placed on developing understanding of the scientific principles that underlie each application.
Introduction to Materials & Processing Technology MATRL-PROC C&D 105420 Grades 9-12	Through manufacturing & construction activities students study the production of products using metal, ceramic, synthetic, and organic (e.g., woods) and biological materials. Experiences also involve management, research, development, marketing and servicing as used by industries providing goods, services & structures.
Technology Specialization II Courses	
These courses help students build **depth** in each of the designated systems of industrial technology. They offer specialization within a system as indicated by their name. Examples include but are not limited to, the following:	
Ceramics, woods, metals or plastics Digital Electronics Alternative energy technology CAD/CAM	Robotics, machine control Engine technology Microprocessor technology Engineering graphics
Materials & Processing Courses	
Manufacturing Technology MFG TECH C&D 105423 Grades 10-12	A study of material processes (separating, combining, forming, conditioning & finishing) in conjunction with the managed sequence of activities used to convert an idea into a useful manufactured product or service.
Construction Technology CONSTR TEC C&D 105424 Grades 10-12	A study of the designing, planning & constructing of a structure on-site. Emphasis will be on pre-construction, construction & post-construction processes from management through actual construction.
Engineering Materials Technology ENMAT TEC C&D 105425	A study of the materials used for technological applications in production. Includes investigations of the properties &

Grades 10-12	testing (destructive and non-destructive) of metals, wood, ceramics, synthetics and bio-tech materials & their implications for energy, communication, and production.
Bio-Technology BIOTECH C&D 105401 Grades 10-12	An interdisciplinary study of the materials and processes used in biotechnology. This course involves biological applications in energy & power, communication, & materials & processing areas such as the production of electricity, digesting of pollutants, biological computing, etc.
Industrial Ceramics Technology IN CER TEC C&D 105421 Grades 10-12	A study of the tools, materials, & industrial processes involved in the manufacturing of products made from nonmetallic resources such as rocks, clay, glass & sand including the industrial ceramic products.
Industrial Plastics Technology IN PL TECH C&D 195422 Grades 10-12	A study of the operations involved in the manufacture and transformation of synthetics (plastics) into usable products with special emphasis placed on technical information, qualities, specifications & standards. Learning experiences include experimenting, creating, designing, fabricating, forming & evaluating plastic products.
Industrial Metals Technology IND METALS C&D 105470 Grades 10-12	Study of the operations involved in the transformation of metal into usable products with special emphasis placed on technical information, qualities, specifications & standards. Activities include experimenting, creating, designing, constructing & evaluating metal products in foundry, welding, sheet metal, machine metal areas and automated &/or computerized manufacturing.
Industrial Woods Technology IND WOODS C&D 105482 Grades 10-12	A study of the woods/cellulose manufacturing industry, the construction of buildings & the production using wood & cellulose products. Learning experiences include experimenting, designing, constructing, operating and evaluating industrial tools, processes, forest products, related synthetic materials, cabinetmaking, woods machining & finishing.
Energy & Power Cluster Courses	
Electricity/Electronics Technology	A study of the sources, measurements,

E/ELTRN C&D 105440	control & application of electrical energy in devices such as those used in heating, power, illumination, communications such as the telegraph, telephone, radio, television, radar & computers. Learning activities include experimenting with designing, constructing & testing electrical devices.
Alternate Energy Systems ALT ENRGY C&D 105413 Grades 10-12	A survey of wind, biomass, solar, geothermal & other nontraditional energy sources, characteristics & applications by means of project & hands-on activity.
Technology Systems Control TECH SYS C&D 105442 Grades 10-12	Study of the control methods used for technological systems such as industrial equipment & processes. Involves the application of programmable controller semiconductors, photoelectric devices, relays, servomechanisms, hydraulics, pneumatics, mechanics, & electronic heating, together with digital principles & applications. Activities include experiments & practical project work.
Power Mechanics Technology POWER MECH C&D 105411 Grades 10-12	A study of the development, transmission and utilization of power including the theory, related physical and chemical principles, maintenance and repair of engines & similar power sources.
Transportation Systems TRANS SYS C&D 105414 Grades 10-12	A study of various transportation systems for materials and people. Trains, cars, boats, airplanes, spacecraft, pipelines & conveyors are sample systems used in the hands-on activities.
Communication Courses	
Architectural Structures & Design Technology ARCH DGN C&D 105431 Grades 10-12	Communicating, through lines & symbols, information about buildings. Activities involve preliminary sketches, plans, models, elevations, sections, detail drawings, the study of architectural design, history of structures, building ordinances, building materials & processes, & computer-aided drafting.
Communications Electronics Technology COM ELECTR C&D 105441 Grades 10-12	A detailed foundation of theoretical knowledge, instrumentation and practical application of electronics used in the communications industry. Instruction & hands-on work includes power, supplies,

	amplifiers, oscillators, transmitters, receivers, electromagnetic radiation & semiconductors.
Drafting & Design Technology DR-DGNTECH C&D 105430 Grades 10-12	Communications of ideas through drawings, sketches, charts, graphs & maps. Develops skills through freehand, instrument & computer drawing involved in lettering, sketching & dimensioning; geometric construction, orthographic & pictorial drawing; auxiliary, section & working drawings.
Graphic Communications Technology GR CM-TECH C&D 105492 Grades 10-12	A study of the tools, materials & processes involved in the mass production of communication by means of photography & printing such as intaglio, relief, screen process printing & thermography. Learning activities include using cameras, developing negatives & making contact prints, enlargements, mountings, composition, imposition, presswork & bindery.
Engineering Graphics Technology ENGR GRAPH C&D 105433 Grades 10-12	A study of the graphic solution to space problems & of the communication of mechanical designs through lines, symbols and drawings. The course involves working drawings, orthographic projection, pictorial views & assembly drawings used in areas such as production, computer-aided drafting, & manufacturing.
Video Production Technology VIDEO TECH C&D 105432 Grades 10-12	Introduces all stages & aspects of production technology involved with video and related electronic media. The fundamental processes and equipment of video production, including synchronization, signal processing, special effects, & electronic editing are addressed.
Level IV: Analysis and Synthesis Courses	
Research and Development RSCH-DEVEL C&D 105406 Grades 10-12	Targeted on developing technological analysis & synthesis skills, this course allows students to pursue relevant technological problems. Considerable independent work is involved in investigating the theory and practice of significant facets of industrial technology.
Enterprise ENTERPRISE	This course involves student establishment and operation of a manufacturing,

C&D 105408 Grades 10-12	construction or service enterprise.
Engineering Technology Education (I-IV) ENG TECH C&D 105407 Grades 9-12	An introduction to the design & engineering processes & materials currently used in structured problem-solving and design. Students explore futuristic trends & current problems as they experiment, research & develop key facets of technology in any cluster. Typically involves cooperative experiences with engineering firms/individuals. Serves as a pre-engineering function for advanced students. May be taught sequentially.
Industrial Technology Problem Solving TECH PROB C&D 105409 Grades 9-12	Detailed study of the processes involved in individual & group technological problem solving. Involves design briefs, prototype solutions & the producing of a working original/model.
Principles of Technology PRIN-TECH C&D 135910 Grades 10-12	Systematic study of the applied physics (optic, mechanics, electronics) underlying most of technology today. Involves experimentation & hands-on activities.
Interdisciplinary Approaches to Industrial Technology INDISCTECH C&D 105402 Grades 9-12	A cross-curricular study of industrial technology, its impacts, and mechanisms. Involves case studies, experimentation & hands-on activities guided by a team of instructors from various disciplines, such as mathematics, science, social science, language arts, & Technology Education.
Other Courses & Assignments	
Other Technology Education Courses O IND TECH C&D 105499 Grades 9-12	Included are other organized subject matter content & learning situations in industrial technology/technology education which are not included in any other course descriptions.
Technology Education Supervision INTECHSUPV C&D 105497	Involves the coordination & supervision of TE programs, facilities and faculty. Typically includes planning, control, management & evaluation responsibilities. (Note: requires TE certification plus a graduate degree in TE)
Technology Education Departmental Duties INTECHDEPT C&D 105498 Grades 9-12	Involves assigned TE program duties other than supervision. Usually a special project, e.g., facility or curriculum updating.

Recommended Industrial Technology Course Content

Each of these courses has competencies presented in groups suggested by major units of instruction as shown below. Some important content topics within each major unit are also provided for overview purposes. These lists do not imply a sequence for instruction other than what is inherent in the content itself. **Instructors may wish to reorganize the content into different units if it is appropriate to their course goals.** Since the implementation of these courses will vary in length, content may be added/substituted as long as the intent of the course, within the scope & sequence, is maintained.

Introduction to Technology
Course Description & Outline

Suggested Major Units of Instruction

1. Overview of Technology
2. Working With Technology
3. Energy and Power Technology
4. Communication Technology
5. Materials and Processing Technology

Introduction to Technology

Suggested Content Outline

1. Overview of Technology
    - What is Technology?
    - How is Technology Organized?
    - What Are the Effects of Technology?
2. Working With Technology
    - Fundamentals of Measurement
    - Information Processing
    - Problem Solving Techniques—Technological Method
    - Group Organization and Management
    - Safety
    - Understanding Work/Yourself
    - Exploring Occupations
    - Computers
3. Energy and Power Technology
    - Overview of Energy and Power Technology
    - Nature of Energy
    - Conversion of Selected Energy Forms
    - Conservation of Energy Resources
    - Choice of Optimum Energy Source
    - Systems of Power Transmission
    - Transportation
    - Selected Emerging Areas
4. Communication Technology
    - Overview of Communication Technology

Elements of the Communication Process
Optical (Visual) Communication Systems
Acoustical (Audio) Communication Systems
Combined Optical/Acoustical (Audio-Visual) Systems
Other Communication Systems
Selected Emerging Areas: Communication Technology

5. Materials and Processing Technology
Overview of Materials & Processing Technology
Industrial Materials
Raw Materials Preparation Processes
Standard Stock Production Processes
Manufacturing Production Processes
Manufacturing Technology
Construction Technology
Selected Emerging Areas: Materials & Processing Technology

End of Introduction to Technology course outline

Exploration of Industrial Technology
Course Description & Outline

Suggested Major Units of Instruction

1. Overview of Technology
2. Working With Technology
3. Energy and Power Technology
4. Communication Technology
5. Materials and Processing Technology
6. Human Resources Technology

Exploration of Industrial Technology

Suggested Content Outline

1. Overview of Technology
    - The Nature of Technology
    - The Organization of Technology
    - The Effects of Technology
2. Working With Technology
    - Fundamentals of Measurement
    - Information Processing
    - Problem Solving Techniques/Technological Method
    - Safety
    - Understanding Work/Yourself
    - Occupational Resources
    - Computers
3. Energy and Power Technology
    - Overview of Energy and Power
    - Nature of Energy
    - Conversion of Selected Energy Forms
    - Conservation of Energy Resources
    - Choice of Optimum Energy Source
    - Systems of Power Transmission
    - Transportation
    - Selected Emerging Areas-Energy Conversion Systems
4. Communication Technology
    - Overview of Communication Technology
    - Elements of the Communication Process
    - Optical (Visual) Communication Systems
    - Acoustical (Audio) Communication Systems
    - Combined Optical/Acoustical (Audio-Visual) Systems
    - Other Communication Systems
    - Selected Emerging Areas: Communication Technology
5. Materials and Processing Technology
    - Overview of Materials and Processing Technology
    - Industrial Materials
    - Raw Materials Preparation Processes

Standard Stock Production Processes
Manufacturing Production Processes
Manufacturing Technology
Construction Technology
Selected Emerging Areas: Materials & Processing Technology

6. Human Resources Technology
Group Organization and Management
Enterprise Simulation
Student Organizations

End of Exploration of Industrial Technology course outline

Introduction to Communication Technology
Course Description & Outline

Suggested Major Units of Instruction

1. Overview of Communication Technology
2. Signs, Symbols and Technical Drawing
3. Printing Systems for Communication
4. Photographic Systems of Communication
5. Telecommunication-Hardwired Systems
6. Telecommunication-Electromagnetic Systems
7. Storage and Retrieval Systems
8. Telecommunication-Audio/Visual Systems
9. Careers in Communication Technology
10. Technological Procedures in Communication
11. Technology
12. Leadership in the Communication Technology
13. Future Trends in Communication Technology

Introduction to Communication Technology

Suggested Content Outline

1. Overview of Communication Technology
    - Definitions
    - Communication System Models
    - Relationship of Other Curricular Areas to Communication Technology
    - Timeline of Communication
    - Special Safety Concerns
    - Careers in the Communication Industries
    - Regulation of Communication
    - Impacts of Communication Technology
2. Signs, Symbols and Technical Drawing
    - Pictographs
    - Alphanumeric Symbols/Messages
    - Technical Drawing Symbols/Messages
    - Careers
3. Printing Systems for Communication
    - Image Transfer Subsystems
    - Production Sequence
    - Equipment and Materials
    - Basic Principles
    - Computer Generated Graphic Reproduction
    - Applications
    - Impact
    - Careers
4. Photographic Systems of Communication
    - Photographic Sub-Systems
    - Production Sequence

- Equipment and Materials
- Applications & Impact

5. Telecommunication-Hardwired Systems
   - Applications
   - Impact
   - Careers
6. Telecommunication-Electromagnetic Systems
   - Electromagnetic Audio
   - Transmission/Reception Systems
   - Applications
   - Impact
   - Careers
7. Storage and Retrieval Systems
   - Historical Systems
   - Modern Systems
   - Encoding and Decoding Used
   - Equipment and Materials
8. Telecommunication-Audio/Visual Systems
   - Television
   - Audio-Visual Projectors
   - Videophones
   - Applications
   - Impacts
   - Careers
9. Careers in Communication Technology
   - Personal Assessment
   - Career Exploration
   - Employability Skills
   - Occupations and Skill Levels
   - Careers and Technological Trends
   - Education and Training
   - Entrepreneurial Endeavors
10. Technological Procedures in Communication Technology
    - Context of Communication Technology
    - Terminology
    - Applications of Technical Communication Systems
    - Regulation and Standardization
    - Problem Solving in Technology (The Technological Method)
    - Impact of Communication Technology
11. Leadership in the Communication Technology
    - Characteristics of Effective Leadership
    - Individual Leadership
    - Group Leadership
    - Student Organization Activities
12. Future Trends in Communication Technology
    - Transmission Systems

Display Technology
Printers
Storage
Microprocessors-“Supercomputers”
Software
Publishing
Impacts

End of Introduction to Communications Technology course outline

Energy & Power Technology
Course Description & Outline

Suggested Major Units of Instruction

1. Energy & Power Technology Overview
2. Technological Procedures
3. Energy Fundamentals: Forms & Conversions
4. Power Technology Fundamentals
5. Instrumentation & Control Fundamentals
6. Energy & Power Technology Applications
7. Electricity/Electronics Technology Applications
8. Careers in Energy & Power Technology
9. Leadership Roles in Technology

Energy & Power Technology

Suggested Content Outline

1. Energy & Power Technology Overview
    - Energy & Power Systems
    - Components of Energy & Power Technology Systems
    - Interface to Communication Technology
    - Interface to Materials & Processing Technology
    - Energy & Power Technology Impacts
    - Safety
    - Scientific Foundations of Energy & Power Technology
2. Technological Procedures
    - Experimentation
    - Information Accessing/Retrieval/Storage
    - Information Processing
    - Information Reporting
    - Innovation
    - Problem-solving Processes
    - Systems Analysis & Synthesis
    - Technology Assessment
3. Energy Fundamentals: Forms & Conversions
    - Basic Definitions and Concepts
    - Energy Measurement
    - Energy Sources
    - Energy Conversions
    - Renewable/Inexhaustible—Non-renewable/Exhaustible
    - Alternative Energy Systems
4. Power Technology Fundamentals
    - Definitions
    - Types of Power Transmission
    - Measurement
    - Power Conversion
5. Instrumentation & Control Fundamentals

Systems Configurations
Types of Instrumentation & Control Systems & Components
Ergonomics

6. Energy & Power Technology Applications
   - Applications in Transportation
   - Applications in Material Processing
   - Applications in Communications
   - Environmental Control Applications
   - Other Applications Areas
   - Power Distribution
   - Ethics
   - Economics
7. Electricity/Electronics Technology Applications
   - Definitions
   - Electricity/Electronics Fundamentals
   - Electricity/Electronics Components
   - Electricity/Electronics Measurement
   - Electricity/Electronics Safety
8. Careers in Energy & Power Technology
   - Personal Assessment
   - Career and Technological Trends
   - Employability Skills
   - Career Directions and Opportunities
9. Leadership Roles in Technology
   - Individual Leadership
   - Group Leadership & Student Organization Activities

End of Energy & Power Technology course outline

Introduction to Materials & Processing

Course Description & Outline

Suggested Major Units of Instruction

1. Materials & Processing Technology Overview
2. Technological Procedures
3. Materials Technology Fundamentals
4. Construction Technology Fundamentals
5. Manufacturing Technology Fundamentals
6. Materials & Processing Technology Applications
7. Careers in Materials & Processing Technology
8. Leadership Roles in Technology

Materials & Processing Technology

Suggested Content Outline

1. Materials & Processing Technology Overview
    - Components & Processing Technology Overview
    - Interface to Communication Technology
    - Interface to Energy & Power Technology
    - Types of Materials & Processing Production
    - Scientific Foundations Materials & Processing Technology
    - Materials & Processing Technology Impacts
    - Safety
    - Management in Materials & Processing Technology
2. Technological Procedures
    - Information Accessing/Retrieval/Storage
    - Information Processing
    - Information Reporting
    - Problem-solving Processes
    - Systems Analysis & Designs
    - Technology Assessment Standards Development
    - Information Applications
    - Impact of Information Technology
3. Materials Technology Fundamentals
    - Basic Classification of Materials
    - Materials Specifications
    - Materials Properties
    - Materials Testing
    - Extraction/Harvest
    - Materials Processing Processes
    - Economic Characteristics of Materials
    - Safety
    - Equipment
4. Construction Technology Fundamentals
    - Types of Structures
    - Types of Construction Procedures
    - Construction Planning

- Construction Methods and Processes
- Materials and Supplies
- Tools and Equipment
- Estimating and Cost Analysis
- Utilities
- Site Preparation
- Safety and Site Security
- Management, Quality and Labor Relations
- Legal Documentation & Requirements
- Sales & Real Estate
- Servicing & Maintenance of Structures

5. Manufacturing Technology Fundamentals
   - Manufacturing Systems
   - Materials and Supplies
   - Tools, Machines, & Equipment
   - Processing
   - Research and Development
   - Management
   - Financing/Enterprise
   - Marketing
   - Safety in Manufacturing
   - Labor Relations
   - Post-processing/servicing
   - Ecology
   - Future Trends
6. Materials & Processing Technology Applications
   - Industrial Technology as Context
   - Terminology
   - Example Applications
   - Quality Control
   - Problem Solving in Technology
   - Materials and Processing Impact
   - Emerging Technologies & Materials
7. Careers in Materials & Processing Technology
   - Career Explorations
   - Personal Assessment
   - Employability Skills
   - Occupations Identification Classifications
   - Career and Technological Trends
   - Education and Training
   - Entrepreneurial Activity & Opportunity
   - Career Forecasting
8. Leadership Roles in Technology
   - Characteristics of Positive Leadership
   - Individual Leadership
   - Group Leadership & Student Organization Activities

Appendices

Appendix A

The *Standards for Technological Literacy*© which can be addressed in this course are:

Standard 1	Students will develop an understanding of the characteristics and scope of technology.
Standard 2	Students will develop an understanding of the core concepts of technology.
Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 4	Students will develop an understanding of the cultural, social, economic, and political effects of technology.
Standard 5	Students will develop an understanding of the effects of technology on the environment.
Standard 6	Students will develop an understanding of the role of society in the development and use of technology.
Standard 7	Students will develop an understanding of the influence of technology on history.
Standard 8	Students will develop an understanding of the attributes of design.
Standard 9	Students will develop an understanding of engineering design.
Standard 10	Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Standard 11	Students will develop the abilities to apply the design process.
Standard 12	Students will develop the abilities to use and maintain technological products and systems.
Standard 13	Students will develop the abilities to assess the impacts of products and systems.
Standard 14	Students will develop an understanding of and be able to select and use medical technologies.
Standard 15	Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 17	Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18	Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19	Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20	Students will develop an understanding of and be able to select and use construction technologies.

Appendix B

The *Missouri Show-Me Performance Standards* which can be address in this course are:

Goal 1.1	Students will demonstrate within and integrate across all content areas the ability to develop questions and ideas to initiate and refine research
Goal 1.2	Students will demonstrate within and integrate across all content areas the ability to conduct research to answer questions and evaluate information and ideas
Goal 1.4	Students will demonstrate within and integrate across all content areas the ability to use technological tools and other resources to locate, select and organize information
Goal 1.5	Students will demonstrate within and integrate across all content areas the ability to comprehend and evaluate written, visual and oral presentations and works
Goal 1.7	Students will demonstrate within and integrate across all content areas the ability to evaluate the accuracy of information and the reliability of its sources
Goal 1.8	Students will demonstrate within and integrate across all content areas the ability to organize data, information and ideas into useful forms (including charts, graphs, outlines) for analysis or presentation
Goal 1.10	Students will demonstrate within and integrate across all content areas the ability to apply acquired information, ideas and skills to different contexts as students, workers, citizens and consumers
Goal 2.1	Students will demonstrate within and integrate across all content areas the ability to plan and make written, oral and visual presentations for a variety of purposes and audiences
Goal 2.2	Students will demonstrate within and integrate across all content areas the ability to review and revise communications to improve accuracy and clarity
Goal 2.3	Students will demonstrate within and integrate across all content areas the ability to exchange information, questions and ideas while recognizing the perspectives of others
Goal 2.5	Students will demonstrate within and integrate across all content areas the ability to perform or produce works in the fine and practical arts
Goal 2.6	Students will demonstrate within and integrate across all content areas the ability to apply communication techniques to the job search and to the workplace
Goal 2.7	Students will demonstrate within and integrate across all content areas the ability to use technological tools to exchange information and ideas
Goal 3.1	Students will demonstrate within and integrate across all content areas the ability to identify problems and define their scope and elements

Goal 3.2	Students will demonstrate within and integrate across all content areas the ability to develop and apply strategies based on ways others have prevented or solved problems
Goal 3.3	Students will demonstrate within and integrate across all content areas the ability to develop and apply strategies based on one's own experience in preventing or solving problems
Goal 3.4	Students will demonstrate within and integrate across all content areas the ability to evaluate the processes used in recognizing and solving problems
Goal 3.5	Students will demonstrate within and integrate across all content areas the ability to reason inductively from a set of specific facts and deductively from general premises
Goal 3.6	Students will demonstrate within and integrate across all content areas the ability to examine problems and proposed solutions from multiple perspectives
Goal 3.7	Students will demonstrate within and integrate across all content areas the ability to evaluate the extent to which a strategy addresses the problem
Goal 3.8	Students will demonstrate within and integrate across all content areas the ability to assess costs, benefits and other consequences of proposed solutions
Goal 4.1	Students will demonstrate within and integrate across all content areas the ability to explain reasoning and identify information used to support decisions
Goal 4.3	Students will demonstrate within and integrate across all content areas the ability to analyze the duties and responsibilities of individuals in societies
Goal 4.4	Students will demonstrate within and integrate across all content areas the ability to recognize and practice honesty and integrity in academic work and in the workplace
Goal 4.5	Students will demonstrate within and integrate across all content areas the ability to develop, monitor and revise plans of action to meet deadlines and accomplish goals
Goal 4.6	Students will demonstrate within and integrate across all content areas the ability to identify tasks that require a coordinated effort and work with others to complete those tasks
Goal 4.7	Students will demonstrate within and integrate across all content areas the ability to identify and apply practices that preserve and enhance the safety and health of self and others
Goal 4.8	Students will demonstrate within and integrate across all content areas the ability to explore, prepare for and seek educational and job opportunities

The *Missouri Show-Me Knowledge Standards* which can be address in this course are:

In Communication Arts, students will acquire a solid foundation which includes knowledge of and proficiency in:

CA 1	Speaking and writing standard English (including grammar, usage, punctuation, spelling, capitalization)
CA 3	Reading and evaluating nonfiction works and material (such as biographies, newspapers, technical manuals)
CA 4	Writing formally (such as reports, narratives, essays) and informally (such as outlines, notes)
CA 5	Comprehending and evaluating the content and artistic aspects of oral and visual presentations (such as story-telling, debates, lectures, multi-media productions)
CA 6	Participating in formal and informal presentations and discussions of issues and ideas

In Fine Arts, students will acquire a solid foundation which includes knowledge of:

FA 1	Process and techniques for the production, exhibition or performance of one or more of the visual or performed arts
FA 2	The principles and elements of different art forms
FA 4	Interrelationships of visual and performing arts and the relationships of the arts to other disciplines
FA 5	Visual and performing arts in historical and cultural contexts

In Health/Physical Education, students will acquire a solid foundation which includes knowledge of:

H 6	Consumer health issues (such as the effects of mass media and technologies on safety and health)
H 7	Responses to emergency situations

In Mathematics, students in Missouri public schools will acquire a solid foundation which includes knowledge of:

M 1	Addition, subtraction, multiplication and division; other number sense, including numeration and estimation; and the application of these operations and concepts in the workplace and other situations
M 2	Geometric and spatial sense involving measurement (including length, area, volume), trigonometry, and similarity and transformations of shapes
M 4	Patterns and relationships within and among functions and algebraic, geometric and trigonometric concepts
M 3	Data analysis, probability and statistics
M 6	Discrete mathematics (such as graph theory, counting techniques, matrices)

In Science, students will acquire a solid foundation which includes knowledge of:

S 2	Properties and principles of force and motion
S 6	Composition and structure of the universe and the motions of the objects within it
S 7	Processes of scientific inquiry (such as formulating and testing hypotheses)
S 8	Impact of science, technology and human activity on resources and the environment

In Social Studies, students will acquire a solid foundation which includes knowledge of:

SS 5	The major elements of geographical study and analysis (such as location, place, movement, regions) and their relationships to changes in society and environment

References

Blais, Richard (2003). *Project Lead the Way*©. Project Lead the Way, Inc., Clifton Park, NY

Desborough, Kristin (1998). Career Path Planning for Secondary Students, Institute for Workforce Education, Instructional Materials Laboratory, University of Missouri, Columbia.

Dyrenfurth, M. J. & Kozak, M. (1991). *Technological literacy*. Fortieth Yearbook, Council on Technology Teacher Education. Peoria, IL: Glencoe/McGraw-Hill.

ITEA (2000). Standards for Technological Literacy: Content for the Study of Technology. Reston, VA: International Technology Education Association.

ITEA (1999). A Guide to Develop Standards-Based Curriculum for K-12 Technology Education. Reston, VA: International Technology Education Association.

ITEA (1996). Technology for All Americans: A Rationale and Structure for the Study of Technology. Reston, VA: International Technology Education Association.

MO DESE (1996). Missouri Show-Me Standards. Jefferson City, MO: Missouri Department of Elementary & Secondary Education.

National Association of State Directors of Career Technical Education Consortium (2002). States' Career Clusters Initiative, Stillwater, OK.

NSF (2003). The Science and Engineering Workforce Realizing America's Potential. Washington D.C.: National Science Board.

Pearson, Greg & Young, A. Thomas, (eds.) (2002). *Technically Speaking: Why all Americans need to know more about technology.* Washington, D.C.: National Academy Press.

Savage, E., & Sterry, L. (eds.). (1990). *A conceptual framework for technology education.* Reston, VA: International Technology Education Association.

The Master Teacher, vol. 21, no. 22, The Master Teacher, Inc., Manhattan, Kansas

The Master Teacher, vol. 25, no. 35, The Master Teacher, Inc., Manhattan, Kansas

Wright, Michael D., and Ben K. Yates, (eds.) (2002) Missouri Technology Education Guide. Jefferson City: Missouri Department of Elementary and Secondary Education, Division of Vocational and Adult Education.